NOVEMBER 1943

The WELDING Journal

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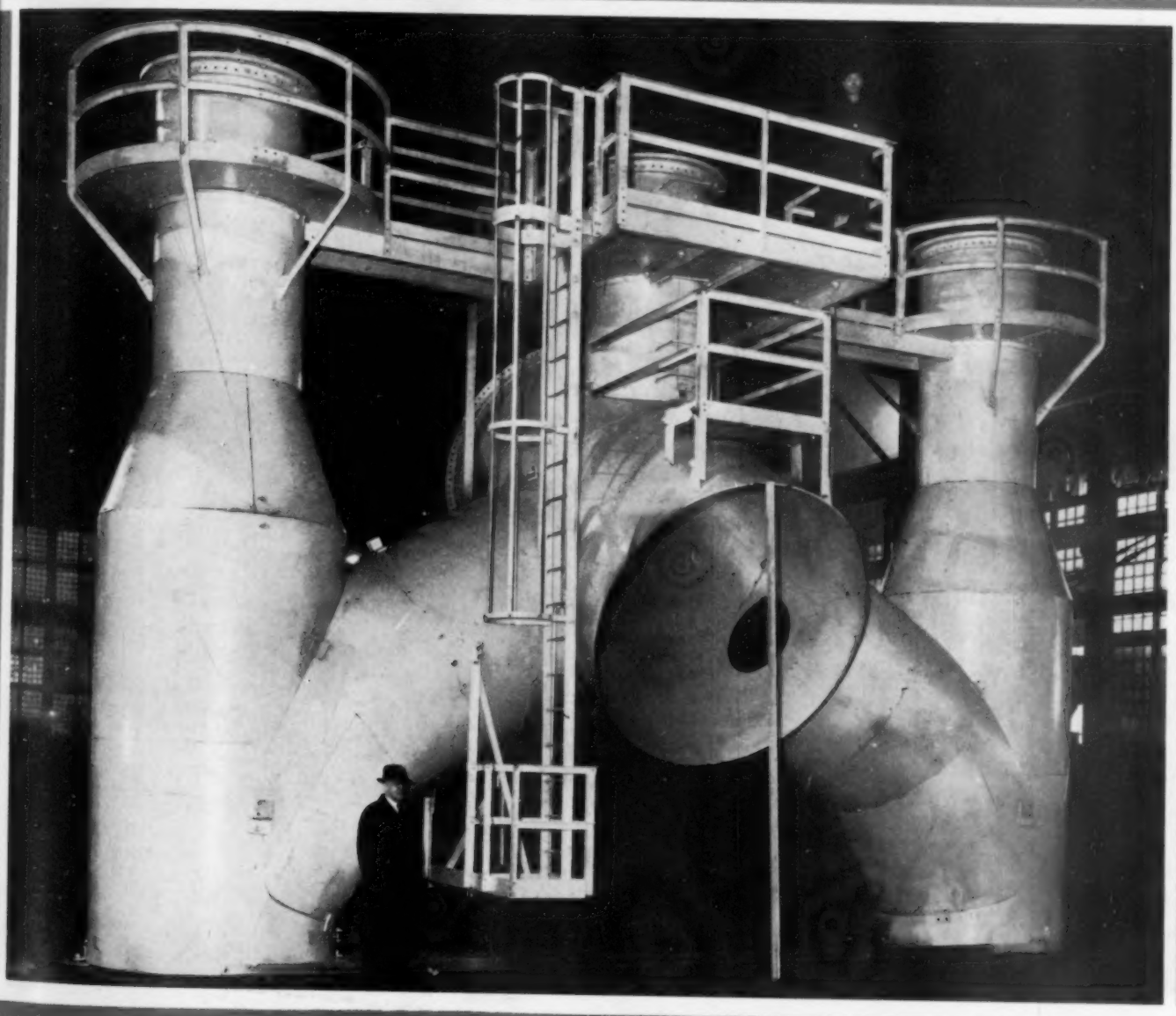

The Journal of the American Welding Society

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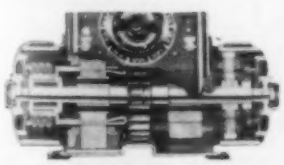

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COVER

Shop Assembly of Welded Uptakes, Cross Over, and Bleeder Platform for a Modern Blast Furnace.
Photo courtesy The William B. Pollock Company.

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Methods of Testing Welds

By H. V. Inskeep*

WELD tests are usually divided into two classifications—destructive and non-destructive—depending upon whether or not the welded part is destroyed during the testing operation. For the purpose of the following discussion, we have reclassified tests into (1) those that can be made in the average shop and (2) those that must be made in a commercial testing laboratory. The first group includes observation, fracture, bend, ductility, pressure and stethoscope tests. The second group includes tensile, X-ray, microscopic and hardness tests.

Observation Test

After a weld has been completed, much can be learned about it by studying its appearance. Of course, this does not mean that the quality of a weld can be determined by its appearance alone—but a weld that fails to measure up in outward appearance is in all probability unsound within.

Smooth, even ripples are a pretty good indication that the operator had the molten metal under complete control. Likewise, the correct contour of the weld, a gentle slope from the center to each edge, as shown in Fig. 1, is good, though not necessarily conclusive, evidence that the weld is a good one. The reinforcement should not be too heavy (see Fig. 2). A maximum height of $^1/_8$ in. above the surface of the plate and a minimum of $^1/_{16}$ in. is usually about right. On certain welded parts, too heavy reinforcements actually weaken rather than strengthen the weld and, furthermore, needlessly waste welding rod, oxygen and acetylene.

* The Linde Air Products Co., Newark, N. J.

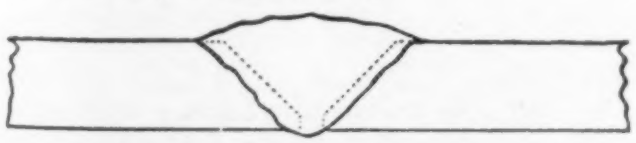

Fig. 1—A Weld Should Slope Gently from the Center to Each Side

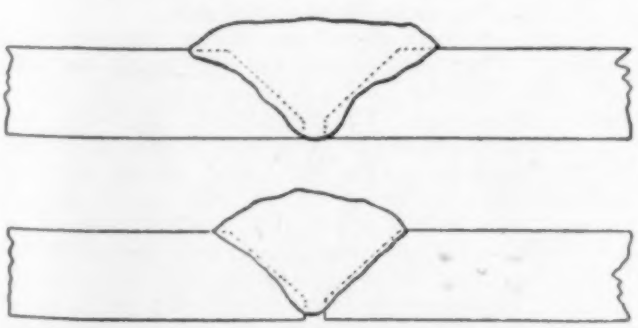

Fig. 2—Excessive Reinforcement Wastes Welding Rod and Gases and Does Not Increase the Strength of a Weld

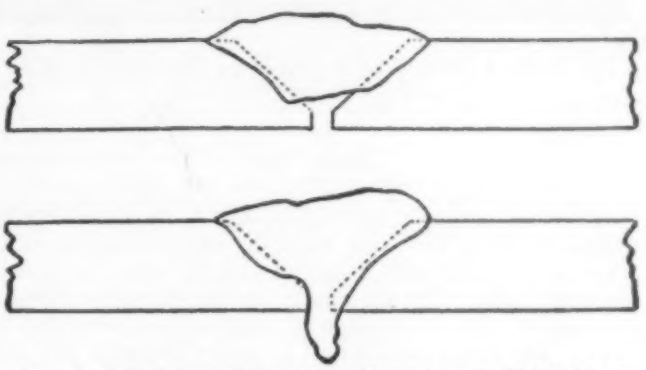

Fig. 3—Insufficient Penetration (Above) and Weld Metal Protrusions (Below) Are Easily Detected

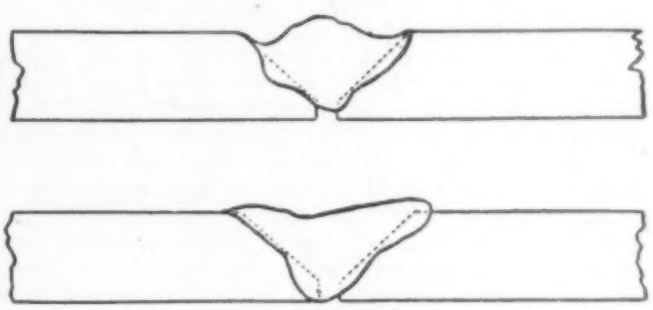

Fig. 4—Undercutting Is a Serious Defect That Greatly Reduces the Strength of a Weld

Lack of penetration is a common fault of the student welding operator that can easily be detected by observation. It is usually caused by allowing the molten puddle of weld metal to be flowed into the vee before the base metal has melted. The result is adhesion instead of fusion. A single vee weld, examined from the under side, should show penetration in the form of a small bead at the root of the weld instead of a void, as shown in the upper sketch in Fig. 3.

Excessive protrusion of the weld metal in the form of "icicles" is almost as objectionable as a lack of penetration, since it indicates that the weld has been overheated and, therefore, has probably been oxidized.

Undercutting (see Fig. 4) is another common fault but one that is not perhaps quite so noticeable to the unpracticed eye. It is a serious defect, because it greatly reduces the strength of the weld. Undercutting in a weld indicates lack of skill—or carelessness—in the operator.

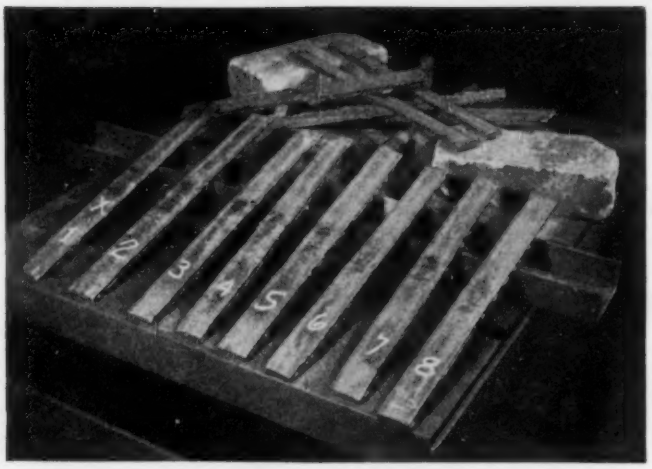

Fig. 5—Bend-Test Specimens Should Be About 1½ In. Wide and Not Less Than 8 In. Long

Bend Test

After the student has completed a thorough visual examination of his trial weld, he should prepare test specimens (sometimes called "coupons") for bend and fracture tests. The specimens are prepared by cutting the welded plate into strips at right angles to the line of weld. The strips should be 1 in. or 1½ in. wide and not less than 8 in. long, with the weld in the middle.

Figure 5 shows a group of test specimens cut from a welded joint in an 8-in. pipe. Place one of the specimens in a machinist's vise with the weld just above the jaws and then bend it over by blows from a sledge hammer. When it has been bent over as far as possible in this manner, readjust it in the vise and draw it up double, as shown in Fig. 6. If it is a good weld (in steel) there should be no cracks or other signs of distress when it is bent to a full 180°, regardless of whether the face of the weld or the root of the weld is on the outside of the curve.

An even more severe test—in fact, one of the most severe tests to which a weld can be subjected—is the free-bend test. In this test, before the specimen is drawn up in the vise as shown in Fig. 6, the ends are first bent with the sledge to about 45° at a distance of about 3 in. on either side of the weld, as shown in Fig. 7. This eliminates any constriction due to the grip of the vise jaws and throws all the strain on the weld when the specimen is bent.

Fig. 6—A Good Weld May Be Bent to a Full 180° Without Signs of Failure

Nick-Break Test

The nick-break test is a test that enables the operator to examine the deposited metal in the interior of a weld. The specimen is prepared by sawing a nick or slot in the center of the weld on each side, as shown in Fig. 8. The depth of the slot should be about 15% of the thickness of the weld, but never deeper than ¼ in. The specimen is then placed on supports about 6 in. apart and broken by a sudden sharp blow. The blow should preferably be applied by a power hammer or a falling weight. Since the cross section of the weld will have been materially reduced by the nicks, the fracture will occur in the weld metal instead of in the base metal or in the area of fusion between the weld metal and the base metal.

Examine the fracture for lack of penetration. This fault is indicated when the weld metal is not fused to the bottom of the vee nor to the lower portion of the side wall. Observe the color and grain structure of the metal. The newly made fracture should have a bright, silvery luster. Discoloration or rainbow hues would indicate that the weld metal has been overheated or burned; and, of course, there should be no laps, slag inclusions, porosity, blowholes or other physical defects resulting from faulty manipulation or bad practice.

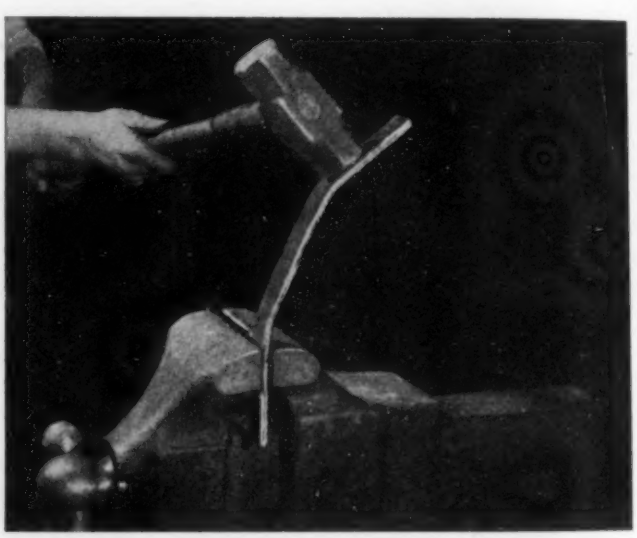

Fig. 7—The Ends of a Specimen for a Free-Bend Test Are First Bent to About 45°

"Laps" or "cold shuts" are due to the method of welding. They indicate that the weld metal was added before the adjacent metal was brought to the correct fusing temperature. The terms "laps" and "cold shuts" are ordinarily applied to such defects when they occur entirely in the body of the weld metal. When they occur between the weld metal and the base metal, they are referred to as "lack of penetration." Blowholes and porosity, which obviously weaken a weld by displacing weld metal, are caused by the generation of gas in the molten puddle. In a correctly executed weld this gas is worked out and released before the weld metal solidifies, but in a poorly made joint the gas is entrapped. Dirty base metal and particles of slag cause the gas to be generated,

Ductility Test

A weld can be tested for ductility at the same time that a bend test is made. Two prick-punch marks are made on the specimen, one on either side of the weld, but not more than 1 in. apart. The distance between the marks is accurately measured with a flexible steel rule, before bending and after bending. Ductility, expressed in percentage, is found by dividing the increase in the distance between the two marks by the original distance between them and multiplying the result by 100. For example, if the prick marks were 0.60 in. apart before bending and 0.75 in. after bending, the increase in distance is 0.15 in. (0.75 minus 0.60). Then the ductility is 25%.

$$\frac{0.15}{0.60} \times 100 = 25$$

Obviously a weld will have little or no ductility but will break at once if the operator has burned the weld metal by overheating it or, by using an excess-oxygen flame, has failed to get thorough fusion and deep penetration, and has not worked out the oxide and slag but has permitted them to become entrapped in the weld. As he gradually overcomes these faults, the ductility of his welds will increase and he will be able to make welds with ductility equal to that of the weld illustrated in Fig. 9.

It should be remembered, of course, that factors other than the skill of the operator can affect the ductility of a weld—such as the kind and quality of welding rod used.

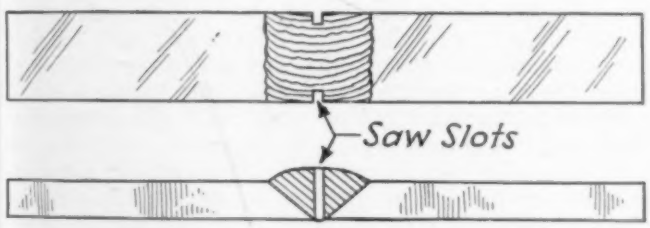

Fig. 8—This Sketch Shows How to Prepare a Specimen for the Nick-Break Test

For example, welds made with one type of rod have an unusually high ductility—about 50%. Welds made with another type rod have ductility around 35%, but they have the compensating property of extremely high tensile strength. The student should therefore use the same rod when making comparative test welds. The simple ductility test will then give him a visual indication of his progress.

Pressure Test

Welds in tanks, containers, piping or other enclosures may be easily and conveniently tested by the application of internal pressure, either with compressed air or with water or oil. In most shops where products of this nature are manufactured on a production basis, pressure tests are routine procedure. Such tests give definite assurance that the product will give satisfactory service under the operating conditions for which it was designed.

The only apparatus required is a compressor or hydraulic pump equipped with a gage and the necessary tubing for connecting the vessel to be tested. This apparatus is available in every modern shop. Wherever possible, hydrostatic (water or oil) pressure should be

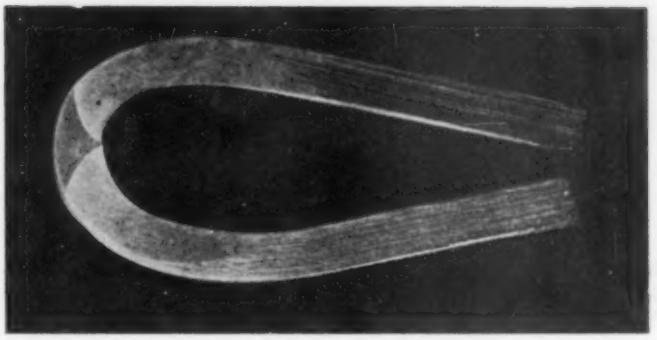

Fig. 9—Note How the Top of the Weld in This Free-Bend Test Specimen Has Stretched

used instead of air pressure. A pump is usually much smaller than a compressor and a high pressure is more easily obtained. Furthermore, a sudden release of pressure is less likely to cause the part to rocket or be thrown about violently.

In applying the hydrostatic test, close the lower openings and outlets in the vessel and fill it completely with water, making sure that no air pockets are left. The upper outlets are then closed. After connecting the pressure line, the pump is operated until the gage shows the desired pressure. This is usually at least one and one-half times the normal working pressure.

The pressure test is one of the most reliable and most satisfying tests to which a weld can be subjected.

Stethoscope Test

The student can perform this test himself with a physician's stethoscope, which can be procured at any first-class drugstore for a dollar or two. Just as a bronze church bell rings clear when whole and produces a shrill note if cracked, so good weld metal gives a ringing sound and poor metal a characteristic flat sound. To identify these sounds, the operator places the stethoscope against the plate and taps the weld with a small hammer as

Fig. 10—Defects in a Weld May Be Detected with a Physician's Stethoscope

Fig. 11—A Sound Weld Made with the Proper Material Is Invariably Stronger Than the Base Metal

shown in Fig. 10. Each welded structure has a characteristic tone. After this has been determined by brief preliminary tapping, the striking hammer and stethoscope are moved along the weld so that any irregularity will be discernible.

The characteristic reedy tone of a defect is sufficiently different from that of a satisfactory spot that anyone after a little experience can detect the difference. Lack of fusion, particularly at the bottom of the vee or along the scarf, gives a noticeably different, reedy, high-pitched initial note. At first a confusing number of sounds will be heard, but the tester will soon be able to eliminate the irrelevant sounds and to recognize sounds that indicate defects.

In applying the stethoscope, it is necessary to hold the end firmly against the plate so that only sounds from the plate will be heard. The end should also be covered with a piece of soft rubber to ensure good contact on the rough surface of the plate.

Laboratory Tests

All the tests discussed thus far can be performed by the operator in his own shop. There are, however, a number of standard tests that must be made in the testing laboratory because of the special apparatus required. These will be discussed briefly.

Chief among the tests in this classification is the tension test for tensile strength. It is used not only for testing the strength of welds but also for testing the strength of base materials. In this test a welded specimen of proper dimensions is placed in a pulling machine with special jaws for gripping the ends of the specimen. Load is then applied until the specimen is pulled in two. If the weld is weak, failure will obviously occur in the weld, but if the weld is sound and has been made with proper material, the break will invariably occur in the base metal, as shown in Fig. 11. The load required to break the specimen is called its tensile strength and is automatically registered on a dial. It is usually expressed in terms of pounds per square inch, that is, in the number of pounds of dead weight required to break a specimen 1 in. in cross-sectional area.

X-Ray Test

Metals can be X-rayed—just as a dentist X-rays teeth—and their internal defects made clearly visible on photographic plates. If there are laps, cracks, blowholes or general porosity inside a weld, the X-ray will reveal the condition.

An X-ray tube is placed on one side of the weld and a photographic plate on the other side. After the proper exposure, depending upon the thickness of the specimen, the plate is developed and can be examined for defects in the weld.

Microscopic Test

Metallurgists make frequent use of the microscope for testing welds in the laboratory. Photographs are taken through the microscope of small sections of a weld, the surface of which has previously been polished. In these photographs the trained eye can detect whether the weld metal was overheated; whether the flame was improperly adjusted, causing oxidation or carburization of the metal; whether there was proper intermingling of the weld metal and the base metal in the zone of fusion; and many other interesting indications of the ability of the welding operator.

Hardness Test

It is sometimes desirable to determine the hardness of the metal in a weld as an indication of its quality. This is particularly true in a cast-iron weld made with cast-iron rod, when machinability is a factor to be considered. There are many different methods of determining hardness. By simply running a file over a weld the operator can determine roughly whether the weld metal is harder or softer than the file and, to a limited extent, whether it is harder or softer than other specimens given the same treatment, and how the hardness compares with that of the base metal. In the laboratory much more accurate means of measuring hardness are available. The machines in most general use for this purpose are the Brinell and the Rockwell. In general, these are alike in principle in that a steel ball or a diamond-pointed cone is forced into the surface to be tested and the resistance to penetration is measured with a high degree of accuracy.

There are many other tests that can be made to reveal the general quality of a weld or to reveal or measure particular properties of a weld. Those we have described, however, are those most commonly used and are the ones that will more easily enable the student operator to check up and improve the quality of his workmanship.

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(*Continued on page 964*)

Welded Weapons in War*

By Col. Scott B. Ritchie†

THE opportunity to discuss a subject vital to our war effort before this distinguished audience is an honor and a privilege I deeply appreciate. I bring to you a personal greeting from our Chief of Ordnance, Major General Levin H. Campbell, Jr., and his thanks and gratitude for the splendid work the AMERICAN WELDING SOCIETY and the other technical organizations and industries who are represented here tonight have done in the production of American Ordnance for our armed forces.

Today, throughout the world on many battlefields, American Ordnance is being tested. These are our weapons of war into which has been and is being incorporated the best that can be provided by our scientific and industrial ingenuity. American weapons are being tested in deadly combat against the greatest array of enemies ever to oppose us in all history. These enemies of ours are armed with weapons which are the products of years of planning and building. They have been aware of the military advantages afforded by technological superiority and have forced the expansion of their scientific achievements with all their might. They know that mobility and surprise and fire power play a decisive role in modern warfare and they have kept busy. They have fast moving, hard-hitting fighting equipment.

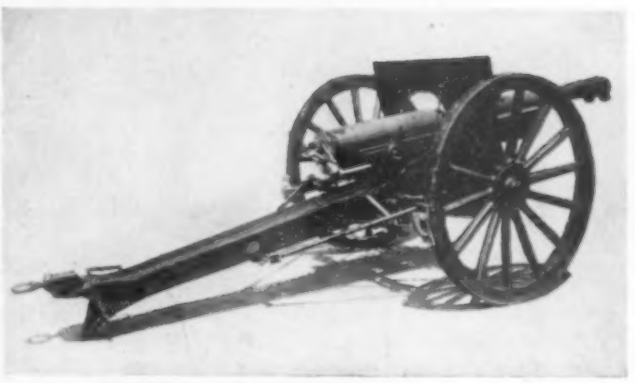


Fig. 1—75-Mm. Gun Carriage, Riveted Construction, Box Trail, Used in World War I

Nor are they standing still for they realize they are now in desperate competition, wherein other things being equal, the side which produces the most effective weapons will surely win in the end. Our enemies know this and they are shrewd and able. Make no mistake about that. Surely, they are doing everything within their power to develop better, new and surprising weapons, and to improve the effectiveness of their existing equipment. We, who are responsible for Ordnance matériel, have been keenly aware of these facts. We know that on the performance and dependability of Ordnance weapons rest the lives of our fighting men—your boys, my boy—and the outcome of the conflict.

We have a sacred duty, therefore, to utilize everything at our disposal to place in the hands of these men who are out there doing the job for us the best tools that can be had under the existing state of the arts and sciences. Even a very, very slight superiority may well be the deciding factor in many issues yet to come.

Our fighting forces are beginning to carry home to the enemy the terrific impact of modern war. We see now in clearer perspective than ever before that their tremendous striking power is based upon weapons produced by American science and American industry through

Fig. 2—75-Mm. Gun Carriage, M2A3, Welded Construction, Split Trail with Greatly Improved Military Characteristics

* Presented at the Annual Meeting, A.W.S., Chicago, Ill., Oct. 18 to 21, 1943.

† Chief, Service Branch, Technical Division, Office Chief of Ordnance.

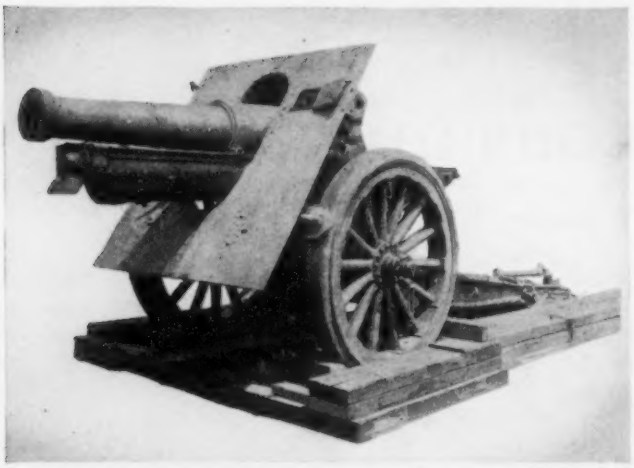


Fig. 3—155-Mm. Howitzer Carriage, Model 1918, Riveted Construction, Box Trail

what General Campbell is wont to call "The Industry-Ordnance team." America at war, just as in peace, forges ahead. Both for research and development of improved weapons and for production of standard weapons, a partnership was early formed by the Ordnance Department with industry. This partnership has brought forth weapons unsurpassed in quality and quantity. As you well know, transforming nebulous ideas into practical realities, giving them form, selecting the materials of construction, deciding upon the methods of fabrication and adapting intricate ordnance designs to mass production are not easy problems. Without the assistance of your superb engineering talent this could not be accomplished. You, and you alone, of industry can produce the weapons required.

This fortunately can be done in the quiet of America. We are so far from the actual combat that it has taken victory to dramatize the significance of superior matériel to us. We have never known the bitter lessons of defeat and chaos close to our own homes. Fortunately, we have never had a Dunkirk twenty miles from our shores to make us feel that tomorrow might bring the enemy's tanks and guns and soldiers into our own cities and homes with the terrifying consequences that would then follow.

We would be even more appreciative of the importance of welding had we experienced nights when the fine margin of superiority in our airplanes, guns and tanks kept us from being shelled and bombed into utter defeat. For welding has done much to keep us above and ahead of the enemy. Industry is now producing weapons in huge quantities. In this, the importance of quality—the superiority of both design and manufacture—daily becomes more important and must not be forgotten in the urgency to produce and deliver.

Welding enters into a large percentage of more than 1700 different weapons with their more than 450,000 components which are furnished to our fighting forces by the Ordnance Department. An exceedingly important element in the quality of these weapons lies in the welding, and you who are assembled here this evening are making a real contribution to these weapons with the amount and quality of welding which you put into them.

Welding is widely used in Ordnance. Vast amounts go into the trucks, scout cars, tanks, and other items which are helping to win battles for our own troops and for our Allies. As you may know, we have changed over from the practice of riveting tanks to welding both armor plate and armor castings. The successful welding of

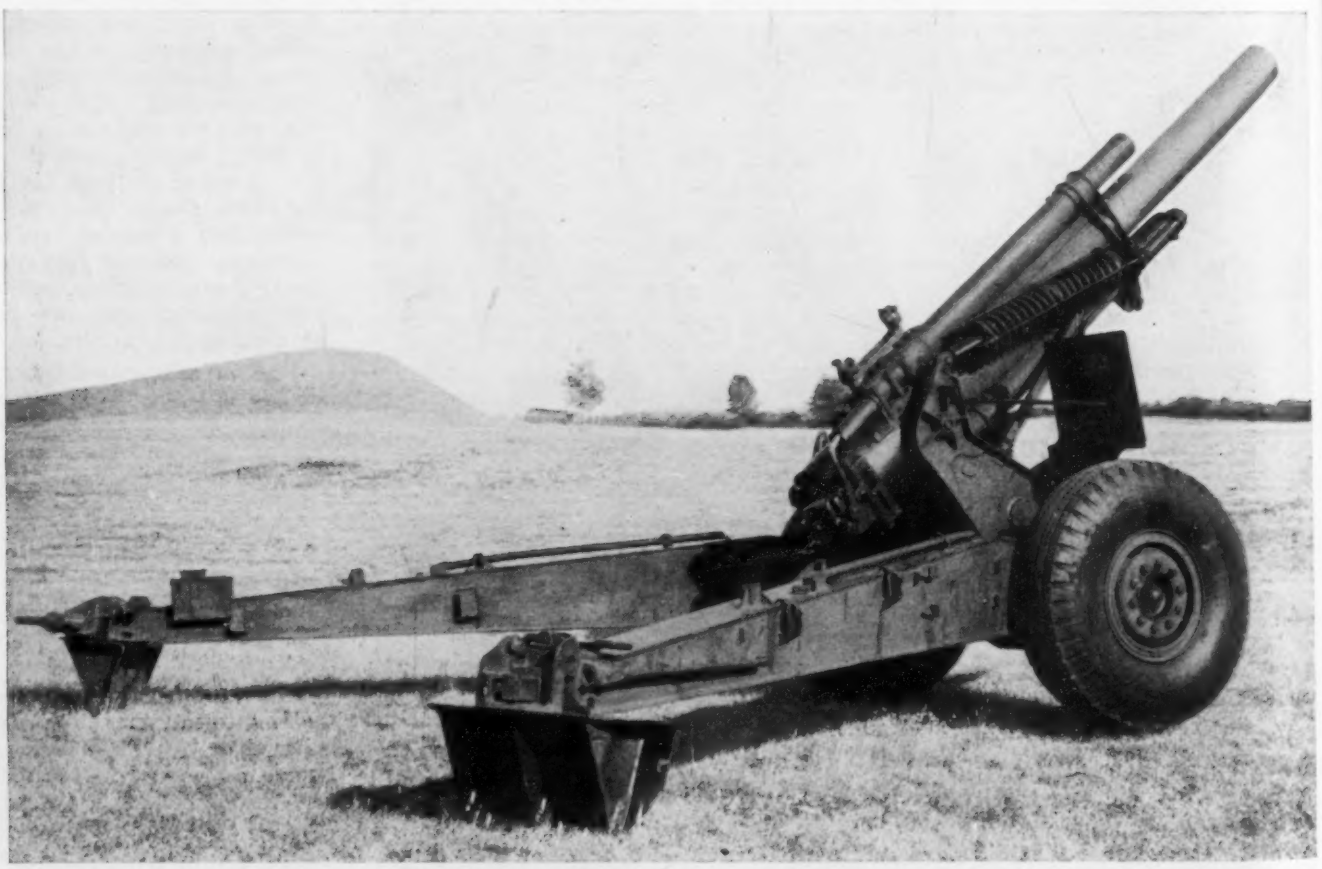


Fig. 4—155-Mm. Howitzer Carriage, M1, Welded Construction, Split Trail with Greatly Improved Military Characteristics

Fig. 5—105-Mm. Howitzer Motor Carriage M7 (Nicknamed the "Priest" from Pulpit Appearance of Machine Gun Mount)

armor in quantity production has not been an easy accomplishment. Broad research programs in this field have been brought to a successful conclusion only by close cooperation between industry and the services. Some of you wonder why it has taken so long to make the final changeover. The reason is that in making a change we must be certain that the change will not lower the quality of the weapon and that production can be assured. We test hundreds and hundreds of sample welds under battle conditions until we are satisfied that the welding process is equal to the best that can be produced.

An agency which has been exceedingly helpful and instrumental in bringing the welding of tank armor to its present state of perfection has been the Subcommittee for Welding of Armor of the Ferrous Metallurgical Advisory Board of the Ordnance Department. This Subcommittee was organized several years ago and has at present some 200 industrial members. It meets from time to time to consider matters pertaining to welding and has been organized into subgroups to emphasize work on electrodes, welding research and specifications. There are representatives from firms in this city who are actively participating in the programs of this Subcommittee.

Another agency that has played a dominant role in industrial mobilization is the Ordnance Procurement Districts. One of these is the Chicago Ordnance District. The Chicago District has helped to make this great city one of the focal points of the war effort. In this the Chicago Sec-

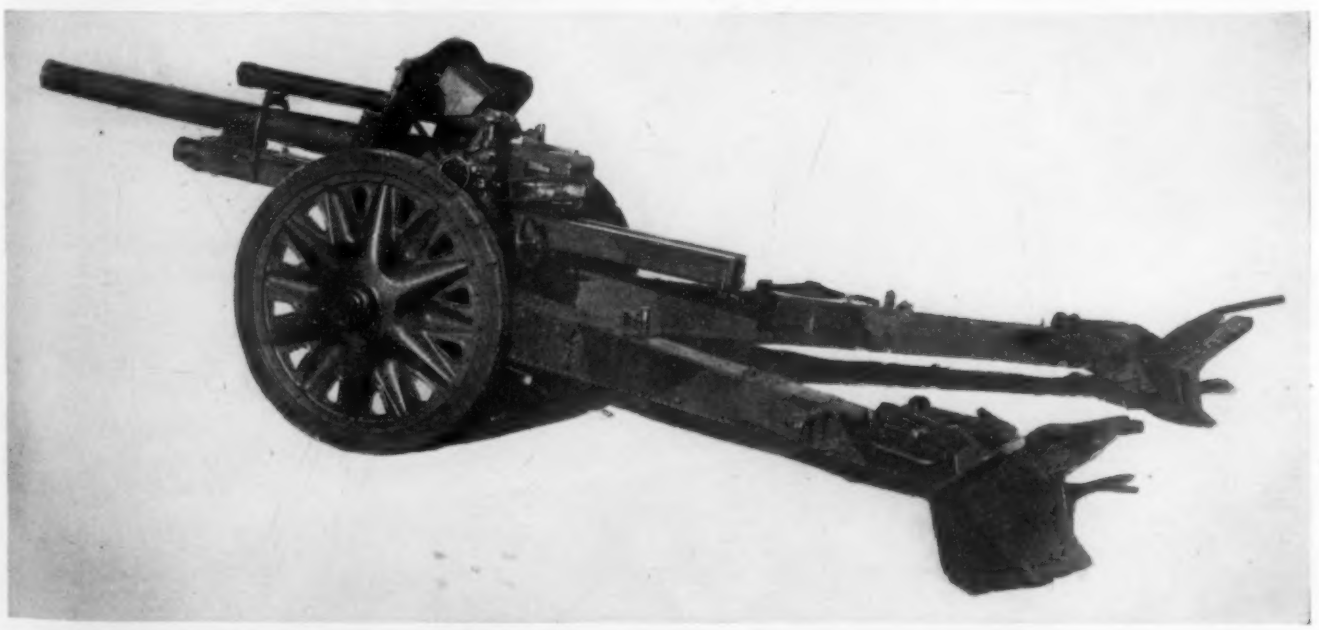


Fig. 6—German 105-Mm. Howitzer. Has Modern Split Trail, But Riveted Construction and Hard Rubber Tires

tion of the AMERICAN WELDING SOCIETY has done its part.

Another important application of welding is in the manufacture of artillery and ammunition. Trench mortar fins are welded onto the body of the shell. Base plates are similarly fastened to the back end of high explosive shells. These insure against possible leakage of the propelling powder gases into the high explosive cavity which might cause a fatal premature. It took welding, both arc and resistance, to give us mass production of bombs—the "block busters" and other super performers, which are now doing to German cities in full measure and to spare what the German bombs did to London, Warsaw, Rotterdam and Coventry. Welding of artillery frames and trails have produced lighter and stronger weapons, and the weight saved thereby has been used to give us greater speed, greater maneuverability and greater fire power.

Years ago Watertown Arsenal pioneered in the application of welding to gun carriages with a net saving in weight of some 30% over the old method of castings and forgings and at less cost and time with a better weapon in the end. Welding has helped to place at the disposal of our Army the finest line of self-propelled artillery in the world. These run from 37 mm. to the powerful 155-mm. self-propelled. Typical is the M7 carrying the 105-mm. Howitzer, nicknamed the "Priest" that first became famous at the Battle of El Alemien.

I need not mention to you welding experts the advantages and disadvantages of welding in fabrication and production. In the improvement of design it has been a wonderful tool in our hands for the manufacture of better streamlined weapons incorporating the essentials for maximum mobility, maneuverability and fire power so vital in modern war. The Ordnance Department has long been an advocate of greater fire power, bigger and stronger guns to deliver a maximum of high explosive and steel for overwhelming destruction at the target. Reports from Tunisia and Italy, and other fronts, from those who know, tell of terrifying artillery fire from American guns and ammunition of almost unbelievable accuracy.

Although welding has its limitations, we can say, however, that it is a powerful tool for producing weapons which otherwise could not be produced. In some of the illustrations will be seen welds which held up under impact of powerful antitank guns. Poorer welds could have meant destruction not only to the tank, but also death to the crew. These men's lives depended on the quality of the weld, the skill with which the welder did his job.

Nor does welding stop when the item is finished in the manufacturing plant. Welding, both arc and gas, plays an important part in the maintenance of ordnance matériel in the combat zone. Each Ordnance Maintenance Company has among its basic equipment arc- and gas-welding units. This equipment includes welding rods of all types. Guns, tanks and motor vehicles, which have been damaged in battle, may be recovered under the blanket of darkness. As an illustration, the advance company may go forward to the damaged item, make the necessary repairs and return the matériel to battle by morning. This battlefield repair often includes welding up shell holes in tanks, repair of broken gun trails and the replacement of attachments which have been knocked off by shell fire or bombs. The men who do this type of work are trained under field conditions by the Ordnance Schools throughout the country. The welding industry, including both fabricators and suppliers, has given the Ordnance Department full cooperation and assistance in the training of our soldier welders. This is another example of industry and the Army working together for victory.

Fig. 7—German Tank PzKw IV. Close-Up Showing Welded Construction of Turret

It is a real pleasure to say to you that not only by engineering tests and examinations, but also and more significantly, by performance in actual combat, our weapons are equal or superior to those of the enemy. This superiority is quite evident in the welds as well as in the complete weapon. Reports which have come in from Bataan, the Philippines, Guadalcanal, Alaska, Egypt, North Africa, Sicily and other places are justification for this statement. For example, Field Marshall Sir John C. Dill of the British Army has praised the important part the Medium Tank M4 played in driving the Germans out of Egypt.

The American landing at Algiers was protected from dive bombing by new, self-propelled antiaircraft weapons. One such weapon brought down nine enemy aircraft; one, while, the weapon was still on a lighter and one while it was on a sea train.

On Guadalcanal our 90-mm. A. A. batteries kept Jap bombers at respectable distances. One battery of four 90's brought down 16 enemy aircraft in two engagements with an average expenditure of 50 to 60 shots per plane from altitudes above 23,000 ft. Our smaller, Automatic A. A. guns were comparably effective against low-flying Jap planes.

Further evidence to support the conclusion on outstanding performance of our weapons is gathered from the battlefields by special Ordnance Observers—officers and enlisted men who have been sent to and are now in all the theaters to collect information on enemy matériel.

Close liaison is maintained with these Ordnance Observers by cable and personal contact by those visiting the various theaters from the Office, Chief of Ordnance. Regular frequent reports are received from the observers, as well as special cables when occasion dictates, so that full advantage is taken of any new developments on the enemy front. As General Barnes,

Fig. 8—Japanese Tank Destroyed in Guadalcanal. Both Riveted and Welded Construction Used

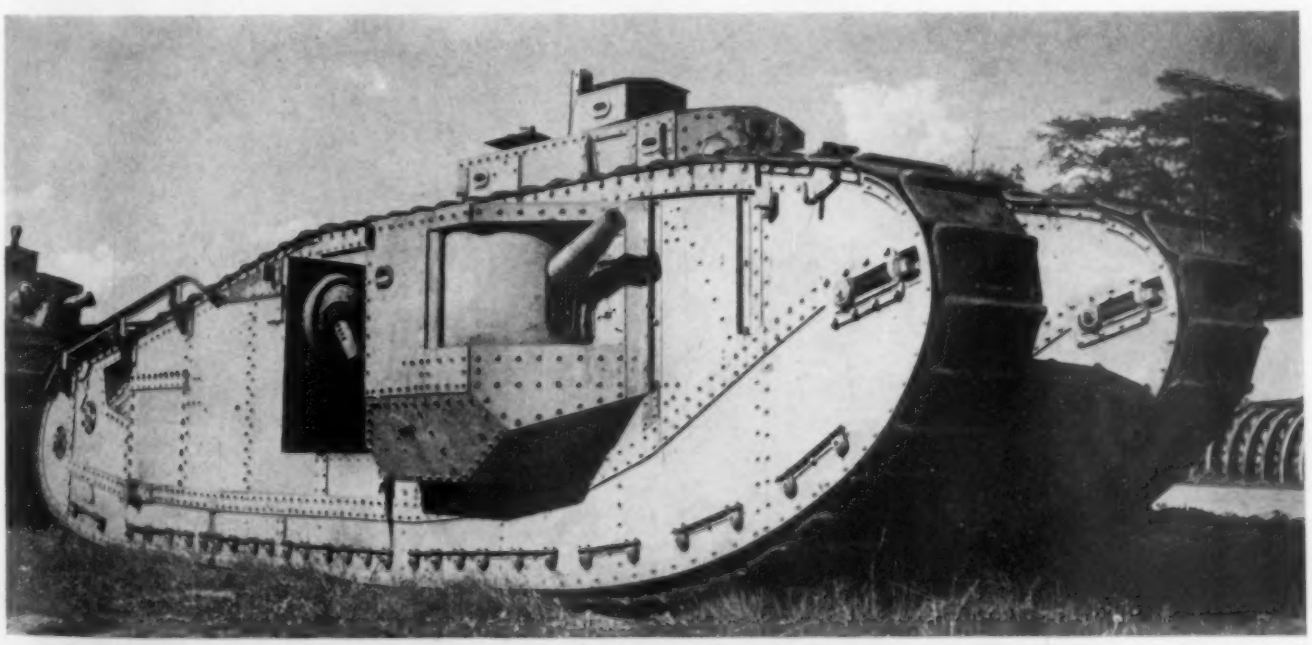


Fig. 9—World War I Heavy Tank, Riveted Construction. The Body or Hull Was of English Design and Manufacture. Armament Was Made in France and the Engine by the United States. This Tank Is a 1917 Model and Had a Top Speed of About 5 Miles per Hour

Chief of the Technical Division, has stated, the objective is to know everything and why about enemy equipment. For example, if the enemy changes the design of a firing pin in a fuse, we not only want to know the change has been made, but also when and why. It is important to know both time and cause immediately any change is made.

In addition to detailed reports of battlefield performance under combat conditions, these observers ship back to us at Aberdeen Proving Ground enemy weapons of every description. At Aberdeen we test these weapons for military functioning and then send samples to our arsenal laboratories, private research organizations and commercial companies for their critical examination. We have examined hundreds of enemy weapons, and while we have found *some* evidence of very fine German welding, there is no doubt that even the Germans cannot maintain a quality of welding in quantity production comparable to our own.

Fig. 10—American Heavy Tank M6, Welded Construction

Reports from the field made after special study of the performance of welded vehicles state that our welded armor has proved satisfactory both under service conditions and against enemy artillery fire. It is reported that welded hulls and turrets behave as if they were seamless. Our troops have remarked on the superiority of our welding of armor over that of the enemy. Welded vehicles blown up by antitank mines show no unexpected signs of weld failure or cracking although other parts of the

Fig. 11—The Renowned M4 American Medium Tank, Welded Construction

vehicles were severely damaged. After thirty hits by artillery fire on our tanks in battle, no signs of weld failure appeared. Experience shows, however, that glance hits are usually high compared with direct hits.

An examination of German welded armor in the field disclosed a few cases where cracks in welds had been repaired before the vehicle had become a casualty. It does not appear that the old welds are cut out before the repair is made. Workmanship is rough and normally ferritic electrodes are used. It is reported that the welds in German tanks perform well under normal service conditions. The behavior of the welding in German PzKw III and PzKw IV Tanks under artillery fire has shown somewhat erratic results. Some of the welds, after repeated hits on the vehicle, give little indication of failure; in others, cracks develop in joints even after a single hit. These cracks may run for considerable distance along the joint.

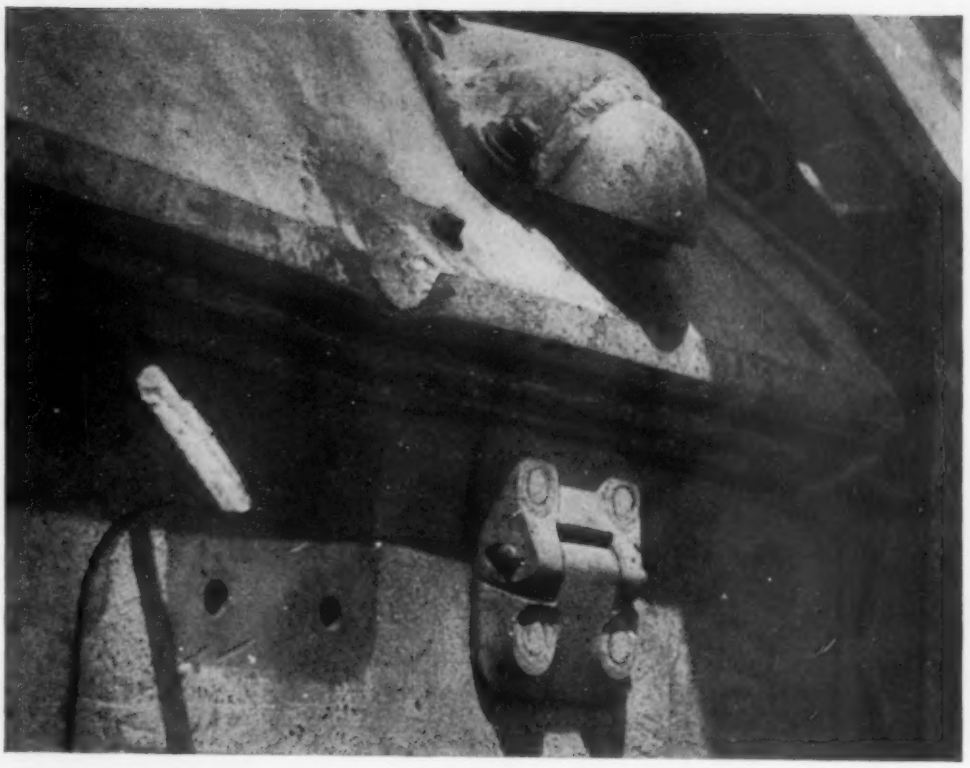


Fig. 12—Projectile Impact on German Tank PzKw III. Typical Weld and Rivet Failures. Note Bolts and Rivets Used on Door Hinges and Small Castings Fastened to Exterior of Tank

11-mm. (0.436-in.) armor taken from a German PzKw III Tank in January 1943 was found to be cross-rolled, homogeneous and good quality steel, quenched and drawn to 320 to 340 Brinell. This armor is similar to S.A.E. 4150 and to some of the armor that was used in this country when riveted and bolted fabrication methods were employed. Fragments in the heat-affected zone adjacent to the weld metal had a maximum hardness of 690 Vickers. In the weld metal itself the maximum hardness observed was 446 Vickers. The welding procedure employed was apparently two-pass sequence. Excessive porosity was observed and it was more prevalent at the fusion line and between the two weld layers. Lack of fusion was especially noticeable between the base metal and the first pass. The chemical analysis of the plate was C 0.44, Si 0.25, Cr 1.30, Mo 0.50, V 0.17, Cu 0.18 and Ni trace. The composition of the armor of a Tiger Tank ran around 0.50%C, 2.50% Cr and 0.60% Mo. The armor was wrought homogeneous with an approximate hardness of 325 Brinell.

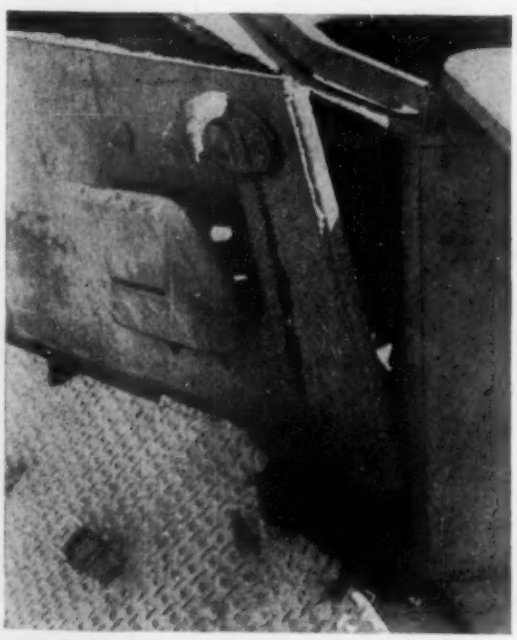


Fig. 13—German Tank PzKw III. Weld Failure Experienced Under Battle Conditions. Welding on This Tank Was Badly Damaged

The German conception of an armor weldment is quite different apparently from ours. It appears that they make an effort to develop in the weld metal a hardness equivalent to that of the base metal. The composition of the weld metal is markedly different from that used in this country and is interesting because of the high-alloy content in the ferritic type weld. In one of the German maintenance vehicles taken in Tunisia we found welding rod some coated and some bare. The bare rods all appeared to be plain low carbon steel. Likewise, the core wires of the coated rods were plain low carbon steel but the presence of silicon and chromium in the coating suggests the possibility of a hard-facing electrode. This will be discussed later.

Some of the salient characteristics of German welding so far observed are:

1. Mortised joint construction.
2. Non-uniform quality of welding with most of it decidedly inferior to American welding as judged by ballistic performance.
3. Susceptibility of failure in the fusion zone of welds under shock conditions in which the welding bead breaks from the base metal sometimes coming out as a strip.

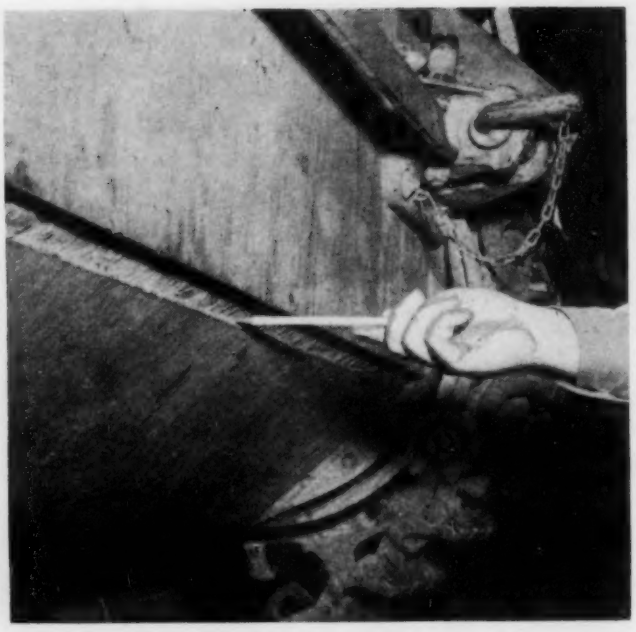


Fig. 14—German PzKw IV Showing Front End Construction. Welding Bead $^{3}/_{16}$ In. Below Edges of Plate

4. In some instances notch not completely filled to surface of plates in face-hardened armor. Usually the weld metal is from $^{3}/_{16}$ to $^{1}/_{4}$ in. below surface of plates of approximately 2 in. thickness, Fig. 14.

5. In cases where the notch is completely filled, the root deposit is of 18–8 austenitic with approximate hardness of 280 Vickers; the center deposit is ferritic or low alloy with a hardness of approximately 440 Vickers; the top deposit is of C-Ni-Cr-Mn-W type with approximate hardness of 525 Vickers.

6. The Germans first used homogeneous plates, then homogeneous plates plus preferential face-hardened plates bolted over the homogeneous plates and separated from them by thin washers; then a combination of two face-hardened plates separated from 4 to 6 in. by spacers with spacers welded to inside plates by outside plates bolted to spacers. They apparently attempted to improvise so as to meet changing requirements imposed by improved projectiles and antitank weapons.

To keep ahead of the enemy, it is, of course, vital to know what he is planning to do. We must know all about his fighting equipment, so that we can take full advantage of it in building and improving our own. The procedure I have mentioned for knowing all about foreign weapons is one means for attaining that objective.

Another—and to us very important—procedure to improve the quality of Ordnance matériel has been the tests conducted under conditions of extreme cold, wind and snow. This past winter, a sizable detachment of Ordnance troops and officers and civilian engineers was established at an Ordnance Winter Proving Ground in Canada. A wide range of Ordnance matériel was involved. It was stored, operated and tested under conditions similar to those which may someday be encountered in Russia, Norway, Northern Germany or other potential battlefields of extreme cold.

Fig. 15—German PzKw III Tank Weld, Broken by Impact of Shell. Note Porosity and Incomplete Fusion

Fig. 16—German Light Tank Remodeled Showing Face-Hardened Space Plate (30 Mm. Thick). Riveted on Front Over Main Armor. Note Effect of Projectile Penetration

These winter tests were exceedingly valuable and developed interesting results. Although certain relatively minor defects were noted, on which corrective action has been taken, it can be stated that our Ordnance matériel as a whole performed exceptionally well under these very adverse cold conditions.

The widespread use of welding in the production of ordnance has saved the Government millions of dollars as well as priceless time, labor and materials. Supply of materials has been a serious problem. Judicious application of welding has helped to ease this problem without sacrificing those elements of safety and dependability in performance which we all so jealously guard. In some cases, welding has speeded the production of vital weapons as much as 250% or more.

The growth in the amount of electrodes used in the entire war effort is very impressive. It might be of interest to note the approximate monthly average consumption of electrodes over a period of years. The figures given were furnished by the War Production Board. In 1937 the monthly average was 11,000,000 lb.; 1938, 8,500,000; 1939, 14,000,000; 1940, 17,000,000; 1941, 35,000,000; 1943, 65,000,000. At present, the rate of consumption of all types of electrodes is more than 80,000,000 lb. per month. The War Production Board reports that there are ample facilities to fulfill any electrode requirements for the calendar year 1944.

In close cooperation with the industry, we are constantly trying to improve the quality of welding and to reduce the amount of critical alloys required. We fully recognize that these two objectives may be quite divergent, yet both must be pursued vigorously.

Due to the scarcity of molybdenum, nickel and chromium, we have as you know, been experimenting with ferritic electrodes on armor plate welding. It is too soon to say what the results of these experiments will be when the welds are subjected to tests under service conditions. This problem is being aggressively investigated by research agencies both within and without the Ordnance Department. We hope for the best.

We are never satisfied even though current production is meeting all specifications. We cannot rest one moment; if we do, the enemy will be ahead. We constantly strive, not only to bring out new and better weapons, but also to improve every weapon and all of its parts. As an illustration of our partnership with industry and the scientific world, the Technical Division, Ordnance Department, has over five hundred different major research and development projects, looking toward the development of new weapons. Most of these projects are conducted on contracts with private industries. Some 450 industrial concerns are involved. In addition, there are several hundred other Ordnance research and development projects seeking to improve materials and processes. We have sponsored with N.D.R.C. over 100 projects, some of which are of transcending importance in the war effort.

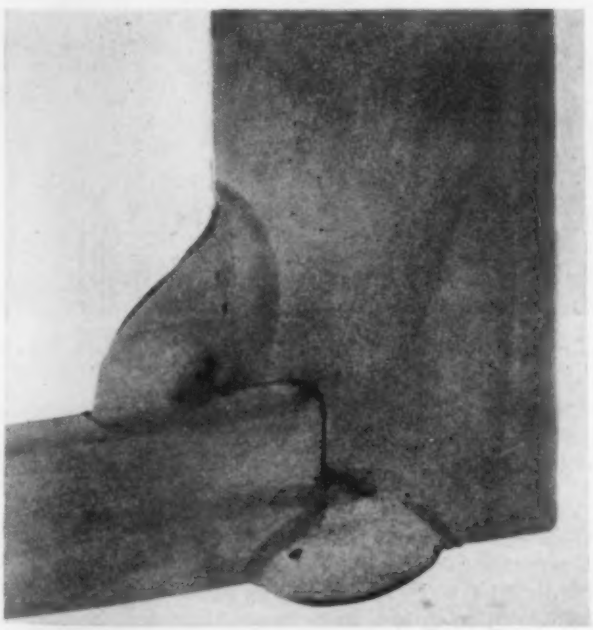


Fig. 17—Macroetched Weldment from German Tank PzKw III Showing Welded Joint Between 30-Mm. Face-Hardened Front Plate of Superstructure and 16-Mm. Homogeneous Armor Top Plate. This Type of Joint Is Typical in German Weldments

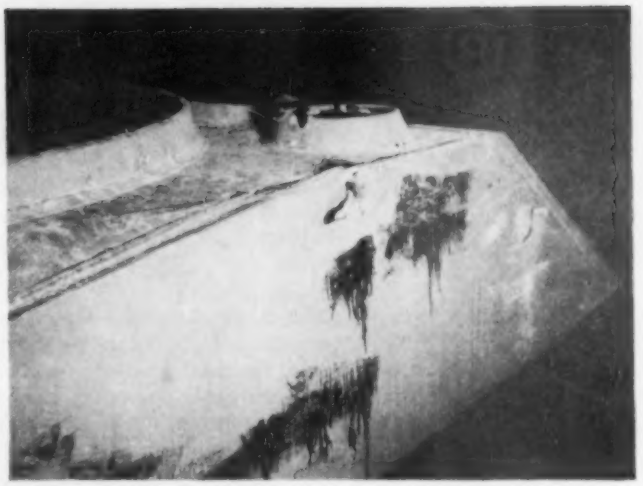


Fig. 18—American Tank Hull Tested at Aberdeen Proving Ground. The Projectile Impact Ruptured and Bent the Armor Plate But Did Not Open the Welded Seam

Welding research and development is an exceedingly important part of this program. The standardization and research activities of the AMERICAN WELDING SOCIETY are of primary interest to the Ordnance Department. We are following very closely its projects administered through the Welding Research Committee which works in close cooperation with the War Metallurgy Committee of the National Research Council, or Division 18, N.D.R.C. With all of these agencies the Ordnance Department desires to cooperate to the fullest extent possible.

To assist in coordinating our part of this welding activity we have set up in the Technical Division, Office, Chief of Ordnance, a section devoted exclusively to welding. Many welding projects of interest to the Ordnance Department are under way. Typical of these are flash welding of alloy steels for Ordnance, development of armor welding electrodes and analysis of locked-up stresses in armor. Such problems as crack sensitivity, weld stresses, behavior of materials under multiaxial stresses and effect of tramp elements in steel and of residuals in weld metal need attention. Much remains to be done, yet I am happy to say with certainty that American welding in all its phases of process and product, fundamental research, production, application, leads the world. Nor does this apply only to Ordnance weapons—an equally fine job, I am sure, has been done and is being done in welding of aircraft and welding of ships. In this the AMERICAN WELDING SOCIETY has done its part and we in the services appreciate that fact. We solicit your further cooperation to insure that the plateau of excellence which you have established shall be elevated rather than lowered, so as to keep pace with the requirements of a world on the march.

With your further indulgence, I would like to present some slides and motion pictures of vehicles and weapons of both our own and of our enemies in which welding is used. Some of these quite vividly show the importance of welding in weapons now in action. (Some of these are shown in Figs. 1 to 11 inclusive.)

In closing, I want to emphasize that our combat forces, as well as the Ordnance Department, look to you as those ultimately responsible for the welding in the weapons that will win the war. Your work can make our weapons lighter, stronger, more effective and in greater numbers. These are factors that will play a vital role in the struggle for victory.

An Aid to Better Welding

By H. H. Griffith*

FOR many welding jobs, a need frequently arises for a fire-resisting compound that can be easily molded to any desired shape. Carbon paste is virtually the only material thus far developed that is wholly satisfactory for this purpose. Unlike clay, plaster of Paris and other molding material, it does not stick to the metal, and does not shrink or crack when heated.

There are a hundred and one different uses for carbon paste in connection with welding. If there is a threaded hole near the break to be welded, it can be filled with carbon paste and thus the oxyacetylene flame will be prevented from burning or otherwise affecting the threads, particularly if they are fine ones. When building up metal around threaded or irregular-shaped holes or when it is necessary to use a blowpipe between machined surfaces, much time and machine work can be saved and a neater appearing job can be done by using carbon paste as a protective covering. It can also be used to protect gear teeth and other finished surfaces that are immediately adjacent to the section being welded.

* The Linde Air Products Company, New York, N. Y.

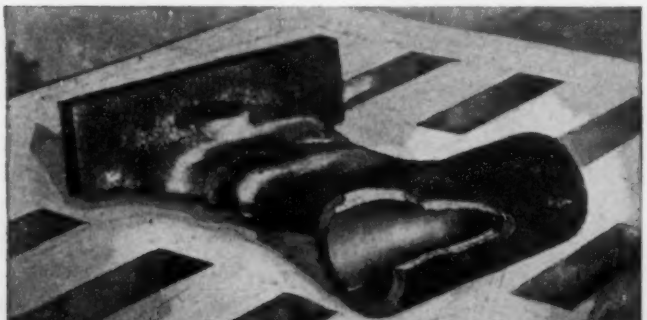


Fig. 1—The Repair of Castings in Which Parts Are Missing Is Often a Problem

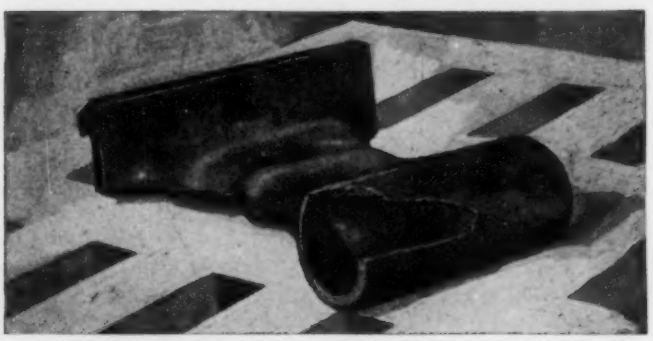


Fig. 2—Carbon Paste Should Be Firmly Pressed in Place and the Surface Smoothed with a Putty Knife

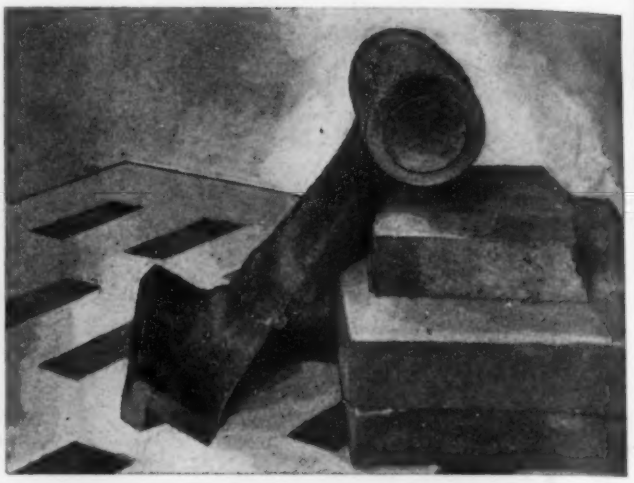


Fig. 3—Machining and Finishing Work Can Be Reduced to a Minimum by the Use of Carbon Paste

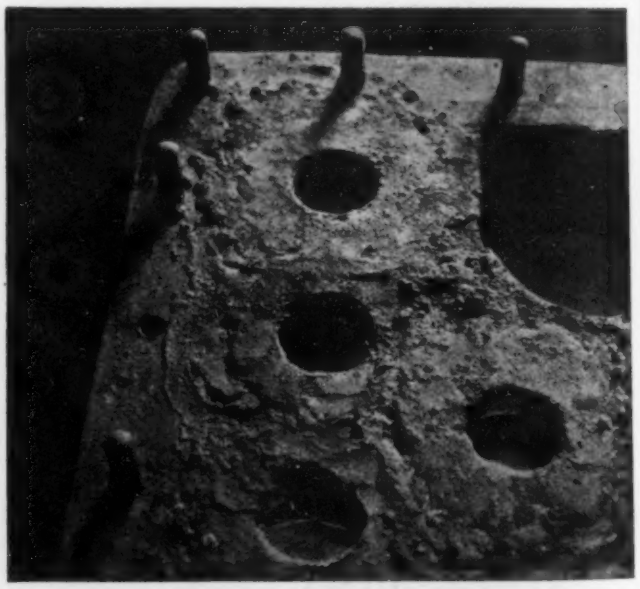


Fig. 4—Carbon Paste Protected the Lower Bronze Suction Seats of This Vacuum Pump During Welding of the Upper Ring Sleeves

Building-Up Operations

Molds for odd shapes or pieces that have been broken off a casting can be easily and quickly fashioned with carbon paste at the point on the main casting where the break occurred, and weld metal flowed in to form the desired shape. Building up a broken gear tooth is a common application of this technique. Obviously the machining and finishing work that would otherwise be required may thus be reduced to a minimum.

Where Parts Are Missing

Castings and other parts requiring repair frequently have pieces of sizable proportion entirely missing. The combined problems of supplying the missing metal and keeping the part in proper alignment are often quite puzzling to the operator. But he can meet this situation confidently if he keeps a supply of carbon paste on hand.

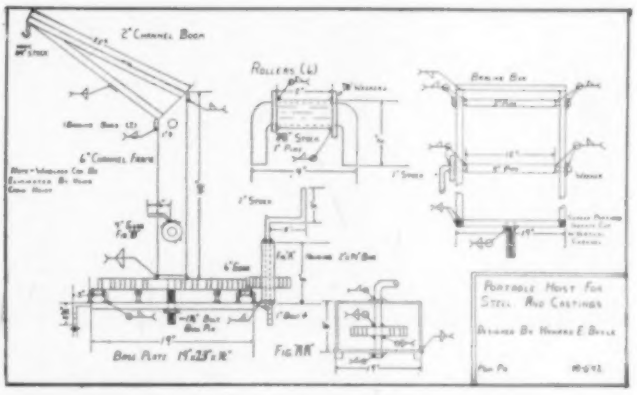
The accompanying illustration is a good example. Figure 1 shows a broken cast-iron support for a drill press table. A roughly triangular piece about 2 in. wide and 4 in. long was missing. The break extended into a threaded hole for a set screw near the center of the casting. Since the operator had a supply of carbon paste available, the repair of this part was relatively simple.

The bore of the casting was filled with paste that was pressed firmly in place and the surface smoothed with a putty knife, as shown in Fig. 2. Provision for the new hole was made by forming a small quantity of the paste into the required shape, using what was left of the original hole as a guide for size and location. The casting was then rebuilt by flowing on metal from cast-iron welding rod and thoroughly fusing it with the base metal. It is obvious that in this particular instance it was not necessary to bevel the edges of the break. Figure 3 shows the casting after it had been welded and annealed. Note the contour of the new section is so nearly perfect that very little finishing work was required. After the casting had cooled, the carbon paste was removed and saved for future use.

Intelligent use of carbon paste by the operator will often save a great deal of time and effort in preparation of the job prior to the actual welding operation—a saving that is most significant, as preparations sometimes consumes more time than the actual welding.

Portable Hoist Built of Stock Pieces and Scrap*

By S. Craig Cairns†



TO SAVE time and labor in lifting large dies and punches for presses, large sheets of steel and steel castings that formerly had been lifted by hand, Mr. H. E. Boyle of Pittsburgh, Pa., designed this one-man operated hoist. Having several hydraulic floor trucks that are used for moving steel, Mr. Boyle utilized one of these for his hoist. By simply removing the hoist from the truck puts the truck back into normal service.

The frame of the hoist is made of 6-in. channel iron (2 pieces 40 in. long and a base channel 19 in. long). Burn the two flanges (on vertical pieces) 2 in. from the end to allow the bottom channel to engage snugly, then weld all around on both sides to insure strength. Bore a $1^1/_2$-in. hole in the center of the bottom flange for a bull pin. The tops of the vertical channels should then be burned off with a 40–0 cut to accommodate the boom (see drawing). The boom is made of 2-in. channel iron 35 in. long (this can vary to suit individual requirements). Weld the boom securely to the frame (flanges facing inward) with double fillet welds on top, bottom and back of each channel. The two top channels are burned at an angle to fit the top of the vertical frame. All four 2-in. channels are toed in in order to meet in the center where they are again securely welded. Weld two bracing bars of 2 x $^1/_4$ x 19 in. to the frame at the tops and bottoms of the angle cut to insure rigidity (see drawing). Weld two bracing bars to the top and bottom of the boom for the same purpose. The boom hook is made of $^3/_4$-in. round stock (an old $^3/_4$-in. eye bolt will serve the same purpose) and is welded to the boom end. Insert a $1^1/_2$-in. bolt in the hole previously bored in the bottom channel and weld all around on both sides. Place the frame with bull pin through shaft hole (shaft hole having been burned level with the gear rim) on an old 19-in. stock gear, and securely weld all around. The base is made of 19 x 23 x $^1/_2$-in. plate, with a $1^1/_2$-in. hole bored through the center. The rollers are made of 1-in. pipe (see drawing) and are laid out and welded to the base plate as shown.

Drill and bend four pieces of $6^1/_2$ x 2 x $^1/_8$ in. and weld to the corners of the plate for anchoring lugs. The 6-in. gear housing is formed by welding a piece of 2 x $^1/_4$ x 19 in. across the tops of the lugs. Form the rest of the housing of one piece, bent in two places, and weld to the bottom piece. Bore a 1-in. hole through top and bottom of housing to accommodate the shaft. Weld gear to shaft and hold into position with two washers welded to the shaft on outside of housing. (Shaft having previously been heated and bent.) The base assembly can then be fitted to the truck by boring four holes through truck sides to fit the lug holes on the plate, thus permitting removal of anchorage of entire hoist by four 1-in. bolts. Fit the hoist assembly to the base assembly and secure by means of a bull pin. The windlass assembly can be made from 1-in. stock and 2-in. pipe with washers holding it in place, and a 4-in. gear welded to the end. Fit a 6-in. dog to engage the gear. Attach a shop block and tackle and the hoist is ready for use. If a chain hoist is obtainable the windlass can be eliminated.

This handy little outfit can be used for almost any shop purpose involving lifting, such as castings, dies, cases, etc., and can be built according to the above plan in not over 3 hr.

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* A prize winning award from *Arc Welding News* Contest sponsored by The Hobart Brothers Co., Troy, Ohio, Manufacturers of Arc Welders and Equipment.

† The Hobart Brothers Co., Troy, Ohio.

Planning for Production Welding and Cutting in a Modern Shipyard*

By W. B. Bowen†

Scope

THE purpose of this paper is discussion of the production methods instituted at the Ingalls Shipbuilding Corporation at Pascagoula and the Ingalls Iron Works at Birmingham, the coordination accomplished at and between these points, the adaptation of our structural fabrication facilities at Birmingham to shipbuilding activities and the organization effected at our assembly shipyard in Pascagoula. All of this has made possible our successful record of building the many all-welded C-3 cargo vessels and C-3 conversions at Pascagoula. We will but lightly touch upon the highly technical, and frequently highly controversial, aspects of welding, and distortion prevention or corrective technique. Instead we will present the methods we have found satisfactory and which have met with the acceptance of the American Bureau of Shipping, the Maritime Commission and the U. S. Navy. For greater detail in technique and procedure control we recommend a review of the many excellent discussions and papers by Messrs. Arnott, Pierce, Wolfe, Grover, West, Offen and others who have covered such details thoroughly and well.

The Ingalls Shipbuilding Corp.

The Ingalls Shipbuilding Corp. operates shipyards at Pascagoula, Miss., and at Decatur, Ala., on the Tennessee River. At the latter point we are engaged in building barges and, more recently, the new N-3-SA2 250-ft. (over-all length) ocean-going coaster, a vessel which will be the subject for another paper at a later date. Up to several years ago the Ingalls Shipbuilding Corp. for many years also operated a barge-building yard, known as the Chickasaw Yard, in Mobile. That yard was discontinued upon the opening of the Pascagoula yard very early in 1939. In all, our company has had better than twelve years' experience in the building of ocean-going vessels.

"The Ingalls Iron Works Company"

The Ingalls Shipbuilding Corp. is owned entirely by the Ingalls Iron Works Company at Birmingham, Ala., as are the plants of the Birmingham Tank Company and the Steel Construction Co. in Birmingham and the Ingalls Iron Works Co. in the Pittsburgh district.

During the depression years of the early thirties, when both the structural and tank business were nearly nonexistent, the Ingalls Iron Works Co. reached for and secured other production outlets. The large building yards at Chickasaw and at Decatur were projected and successfully realized, and a wide experience in and detailed knowledge of welded-vessel construction were developed. In January 1939, forty-six acres of waterfront were secured at Pascagoula for the accomplishment of a contract with the U. S. Maritime Commission for class C-3 vessels.

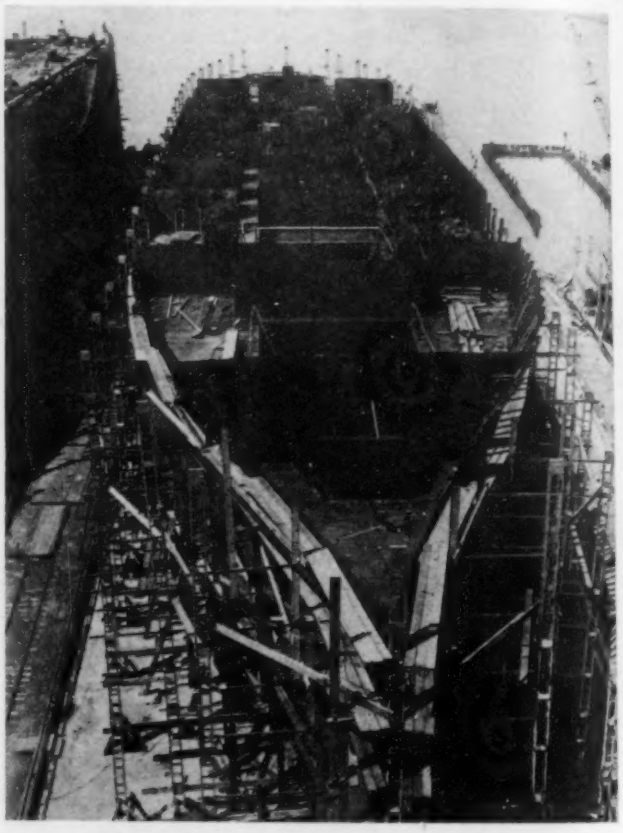


Fig. 1—The All-Welded C-3 Cargo Vessel Structure Is More Complex Than the Liberty Ship. It Is 492-Ft. in Over-All Length, 6 Ft. 6 In. in Beam, 42 Ft. 6 In. in Molded Depth. It Has a Total Displacement of 17,600 Tons

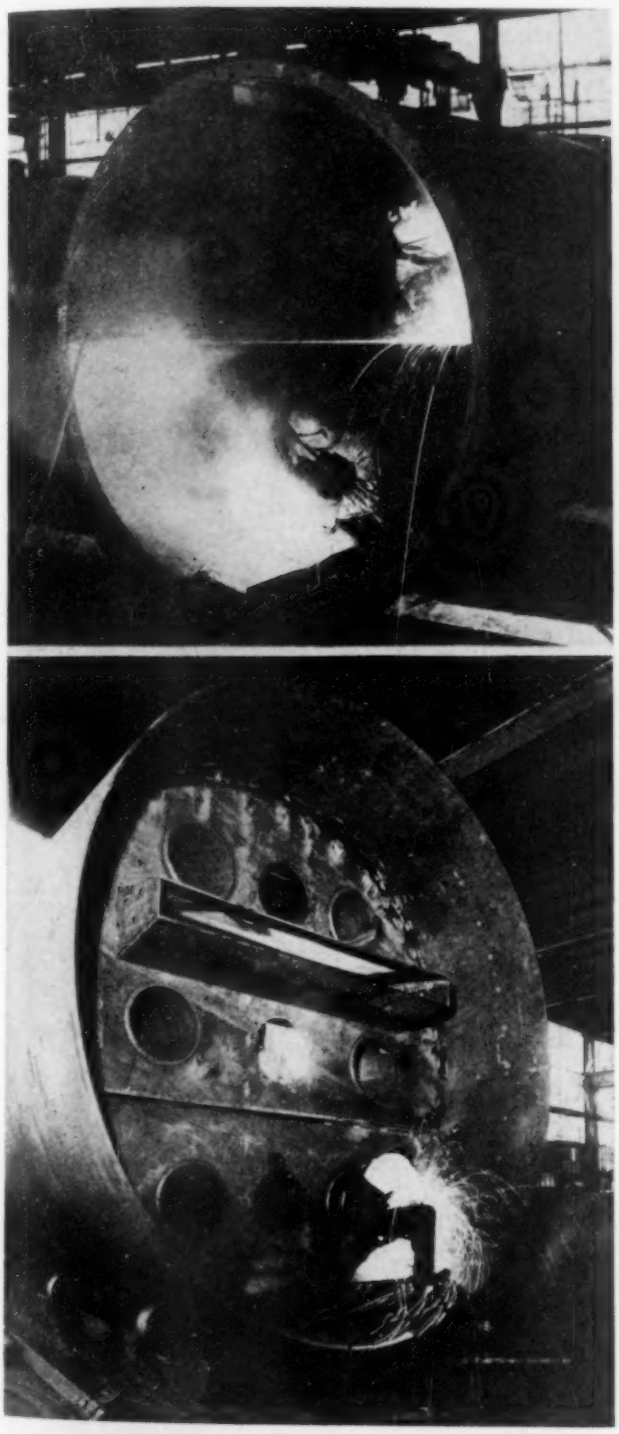
The C-3 Vessels

The C-3 vessel constructed at our yard is a graceful all-welded ship without a single rivet. It is 492 ft. in over-all length, 69 ft., 6 in. in beam and 42 ft., 6 in. in molded depth. It is intended for permanent ocean-going service and its design allows for ready conversion to cargo-passenger, transport or even naval craft. The construction is much more complex than that of the Liberty

* Presented at the Annual Meeting A.W.S., Chicago, Ill., Oct. 18 to 21, 1943.

† Welding Superintendent, Ingalls Shipbuilding Corp., Pascagoula, Miss.

vessel, as will be observed in Fig. 1. We have built a number of these ships prior to and since Pearl Harbor, and their records are excellent. The *Exchequer*, the first of these vessels, was the first large cargo vessel to be constructed throughout by the electric welding process in the United States. The *Mormacmoon*, delivered on Dec. 31, 1940, was the first all-welded ocean-going dry-cargo vessel in the American Merchant Marine. With a full cargo it established a record by making a 4151-mile cruise at an average 17.9 knots per hour at 28 ft., 4 in. draft, and consuming only 0.908 barrel of fuel oil per mile.



Figs. 2 and 3—In Straight Fabrication the Essentials of Land-Borne Structural Fabrication and Merchant-Vessel Fabrication Are Essentially the Same, as Will Be Seen in Fig. 2, Above, Which Is a View of the Welding of a Section of Inner-Stack Above the Fidley Top for a C-3 Vessel. Below, in Fig. 3, Is a View of the Welding of an End Section at the Tray of a Gasoline-Stripping Tower

Fig. 4—One of the All-Welded Facilities at the Ingalls Birmingham Fabrication Plant Is This 600-Ton Press 30 Ft. Long for Bending, Forming and Flanging Various Structural and Ship Members

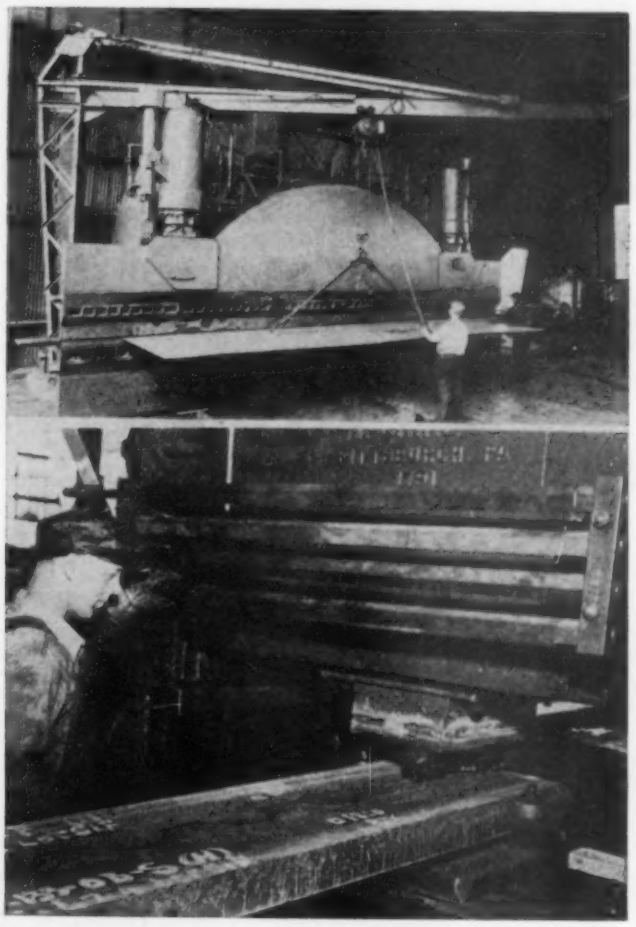


Fig. 5—Structural Fabrication Machinery Has Been Modified and Adapted to the Fabrication of Ship Sections. This Thomas Spacing Machine with New Dies for Punching These Serrations in Ship Beams Is a Typical Example

Ingalls Production Plan

The Ingalls shipbuilding plan envisages the utilization of the extensive structural fabrication facilities at its Birmingham plants for the purpose of sizing, shaping, forming and assembling as many of the sections, primary assemblies and subassemblies as may be shipped to the Pascagoula yard by rail or truck. Later, probably, they will also travel by water inasmuch as Birmingham is situated on a river which has its mouth on the Gulf of Mexico. Steel from the nearby mills at Birmingham, or from more distant points, is shipped to the Birmingham fabrication plants where it is cut by oxyacetylene torch or other means and processed. The parts are arc welded into minor assemblies and shipped to Pascagoula, 350 miles distant, for final assembly on the ways or for welding into larger subassemblies in the yard.

The principles of prefabrication are not new. Ingalls has employed them since the establishment of its barge-building yards at Decatur and Chickasaw. It was found then that prefabrication greatly reduced the time for construction and that the building of minor assemblies at remote points allowed for the expansion of the program to any required extent.

Adaptation of Facilities

At an early date in the development of our C-3 building program and our prefabrication program at Birmingham, it was decided to base our production there on the fabrication of the total complement of units for five ships at a time. This would insure our not being behind the erection schedule at Pascagoula and prevent overloading of transport and storage facilities; and, in addition, it would not project an abnormal demand for steel of certain sizes and weights.

As far as straight fabrication is concerned, there is little difference between the essentials of land-structural boiler and tank fabrication and the essentials of ship-plate and ship-structural framing for primary and sub-assemblies. This may readily be observed by comparing Fig. 2, a view of the welding of a section of the inner stack above the fidley top for a C-3 vessel, with Fig. 3, a view of the welding of an end section at the tray of a huge gasoline-stripping tower; both were constructed at our Birmingham fabrication plants. The similarity of the two jobs illustrated shows why our organization easily qualified for shipbuilding fabrication to the extent of nearly 80%, by weight, of the steel for these ships. Nor is size of unit too great a hindrance, as we can ship by rail units 14 ft. high by 4 wide or wider sections of lesser height.

Almost all of our structural fabrication facilities, such as bending presses, radial drills, rolls, shears, punches, spacers, etc., formerly required for straight structural fabrication are now being used either as is or slightly modified to turn out ship parts. Of interest to a welding audience is an all-welded facility constructed in our own plant, as seen in Fig. 4. This hydraulic press brake has a capacity for 600 tons at 2360 psi. or 500 tons at 1970 psi. It has a throat 30 ft. long and is utilized for bending, forming and flanging plates for pontoon hatch cover members, spreading angles and flanging plates for beam and girder constructions. It is essentially of all-welded construction of $1^1/_4$-in. to 3-in. plate thickness. In another instance we have converted an all-welded dishing press into a straightening press for deep tank hatch covers. In Fig. 5 we note the converted use of a Thomas spacing machine. Fitted with dies it now spaces and

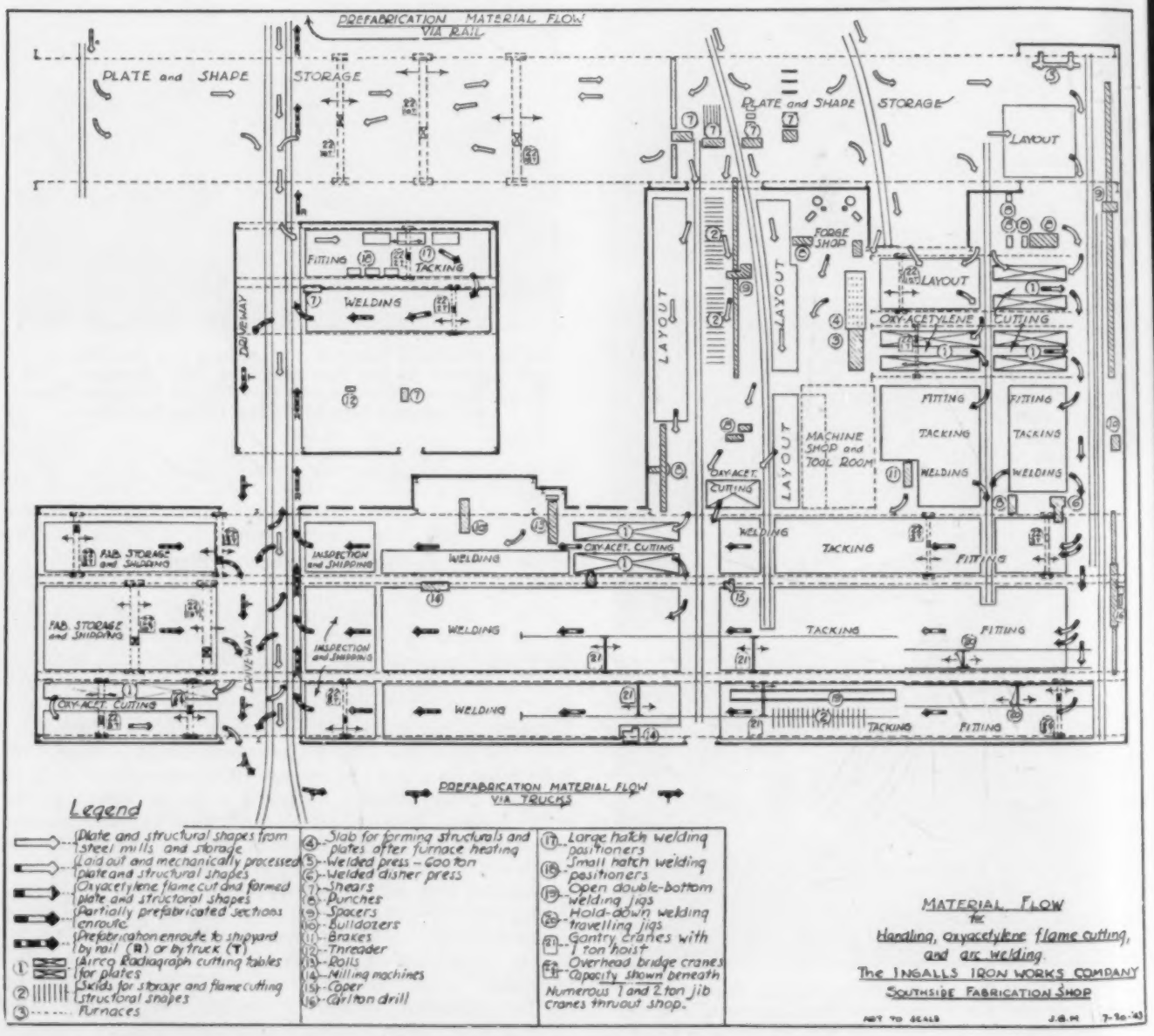
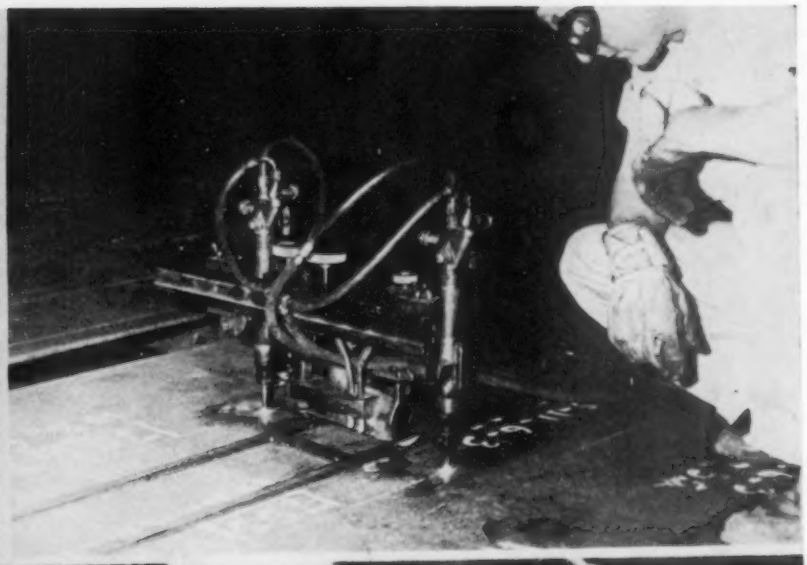


Fig. 6—A Diagrammatic Plan of Material Flow at the Birmingham Fabrication Plant. It Will Be Noted That This Plant, Originally Designed for Land-Borne Structural Fabrication, Has Been Entirely Converted for the Fabrication of Ship Subassemblies

Fig. 7

Fig. 8



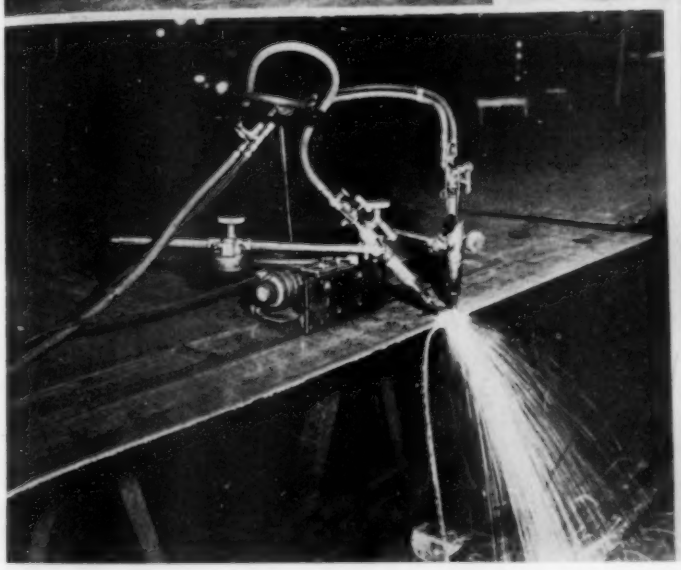


Fig. 9

Fig. 10

Fig. 7—One of the Larger Radiagraph Cutting Table Bays at Birmingham. Overhead Bridge Cranes Quickly Deliver Raw Material and Remove Flame-Cut Shapes. It Is an Important Unit in the Production Line

Figs. 8, 9 and 10—All of the Machine Flame Cutting for These C-3 Vessels Is Accomplished with Either Single or Multi-Torch Set-Ups on Radiagraphs. Parallel Cutting, Single and Double Beveling with Lands, Single, Double and Triple Torch Operation, Flange-Splitting and Circle-Cutting, All Fall Within the Range of Operations Performed with This Portable Equipment

punches out serrated deck beams from channels 15 in. deep. This design of beam permits ventilation under the decks, results in considerable weight reduction and, as the full length of the tooth is welded to the deck plate underside, assures correct and uniform weld lengths. Another example of conversion is the present use of a Thompson-Gibb spot welder for welding woven screen to the frame angles for wire mesh bulkhead.

Material Flow

In view of the changeover from an all structural and plate shop of the customary mechanical process layout to one comprehending at least 70% of its area devoted to oxyacetylene cutting and arc welding activities, it became necessary that a comprehensive employment of all crane and material handling facilities be worked out with, as nearly as possible, a production line procedure and movement of raw, semi- and wholly fabricated material. It will be well, therefore, before proceeding further, to study the material flow at our main Birmingham fabrication plant. This is shown in diagrammatic keyed form in the plan in Fig. 6. The details are self-explanatory and it will be noted that raw plates and shapes fed into the plant at the upper right proceed through the layout and oxyacetylene cutting areas to the fitting and tacking bays, to the finished welding zones, to inspection and storage and, finally, by truck or rail to Pascagoula.

Fig. 11

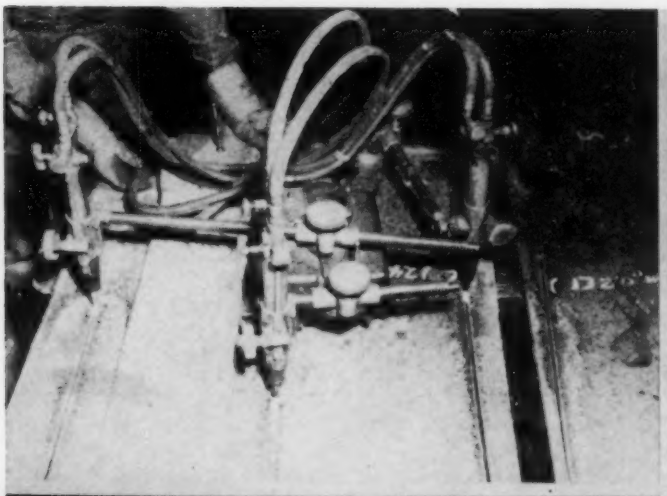
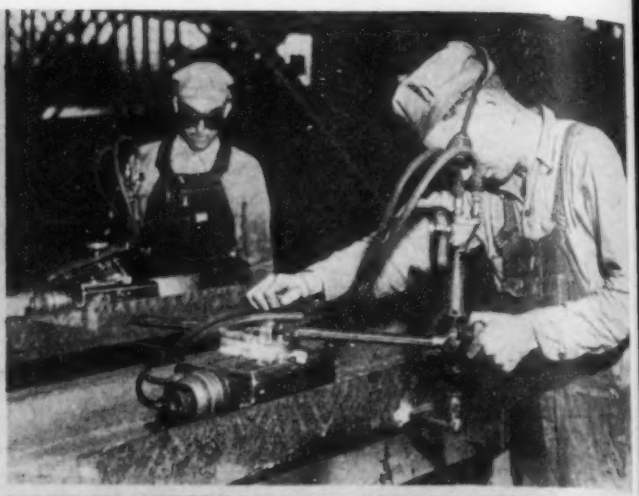


Fig. 12



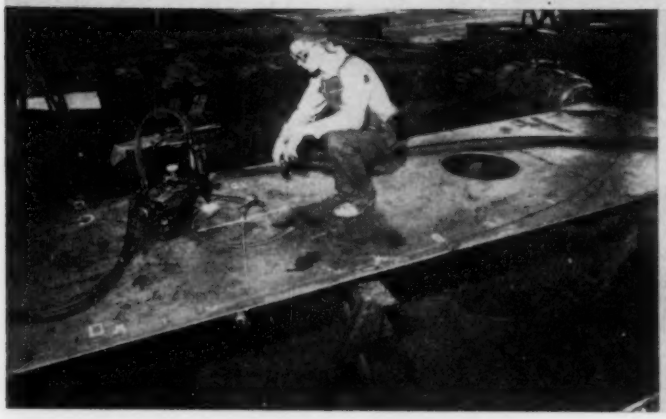


Fig. 13

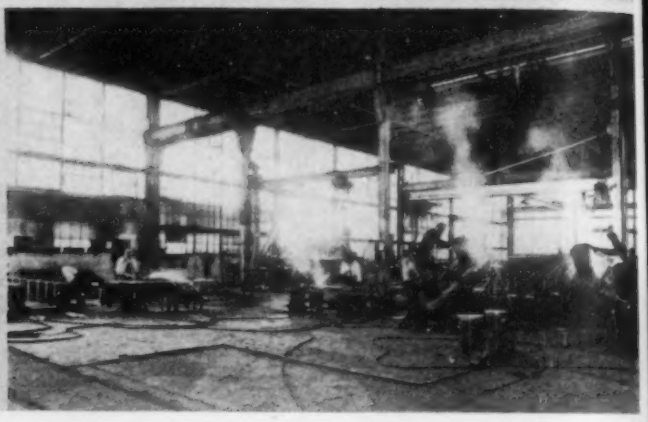


Fig. 14

Figs. 11, 12 and 13—Some Further Examples of the Versatility of the Radiagraph Are Shown in These Illustrations. Fig. 14—Wherever Possible, Departmentization Is Established, as in the Case of These Mooring Bitts

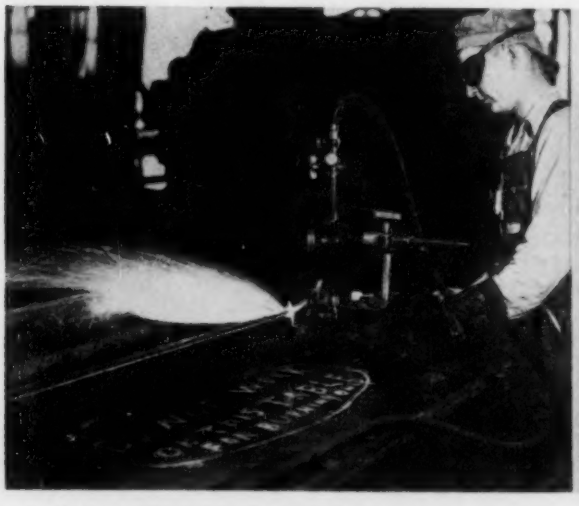


Fig. 15—An Operator with the Radiagraph Trimming the Edge of the Base

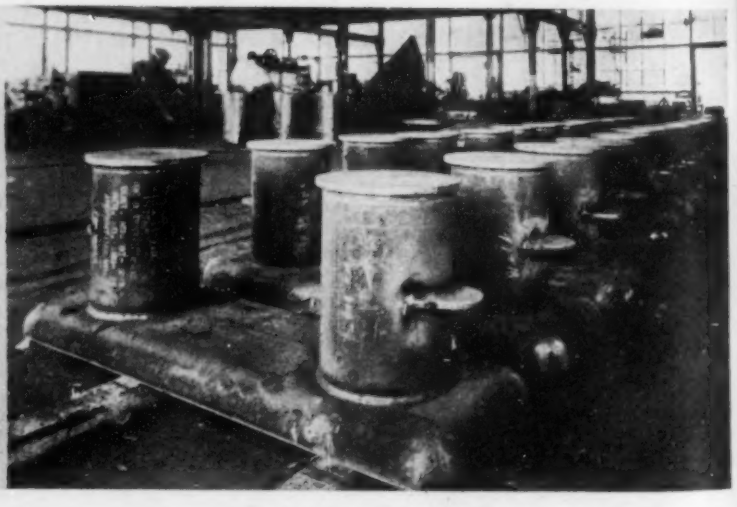


Fig. 16—The Completed Bitt

Oxyacetylene Cutting

It is possible that we are unique in the fact that we, to date, have found the portable and versatile Radiagraph adequate for performing all of our machine gas-cutting operations. This applies to both our Birmingham plant, now being discussed, and our Pascagoula yard. We have solved our problems by using the Radiagraph as frequently as possible in coordination with our standard mechanical facilities and by devoting large cutting table areas for this purpose. The Radiagraph's value in this application lies in its ability to carry multiple-torch setups, to circle cut and to single and double bevel. A view of one of our larger Radiagraph

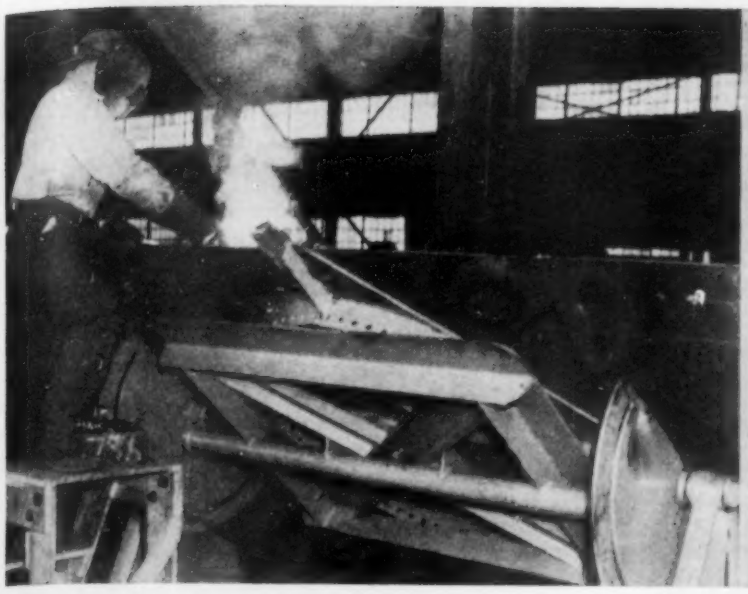


Fig. 17—A Shop-Made All-Welded Positioner with Two-Plane Adjustment and Work Face for Accommodating Small Hatch Covers, Doors, etc.

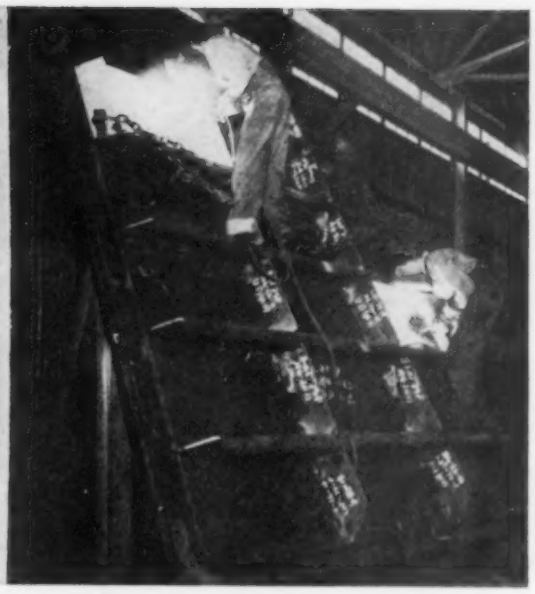
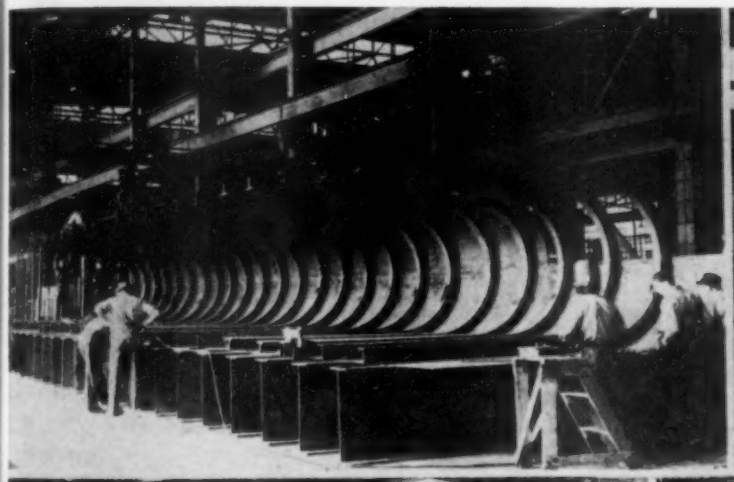
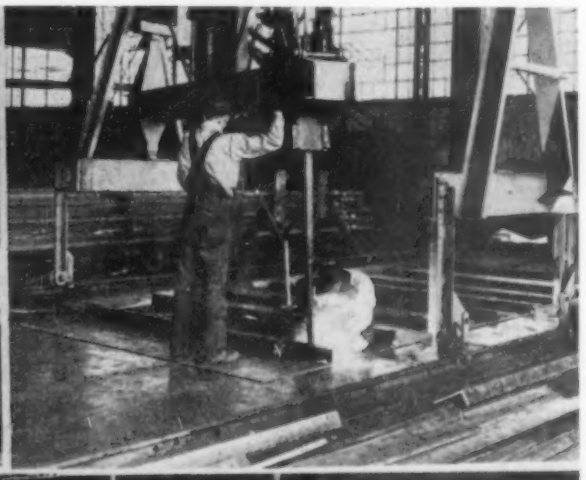


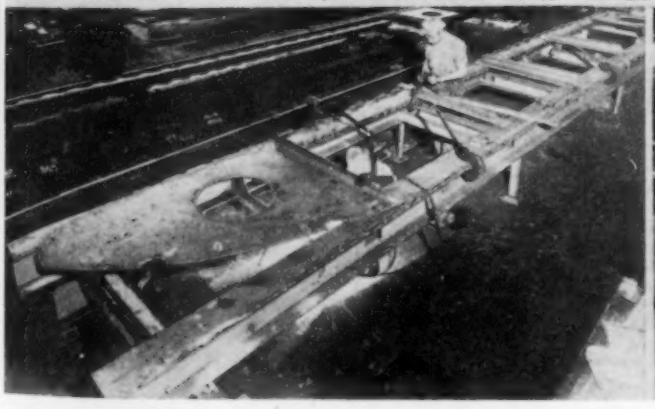
Fig. 18—A Fixed Angle Positioner for Providing Downhand Welding on Deep Tank Hatch Covers

Fig. 19

Fig. 20







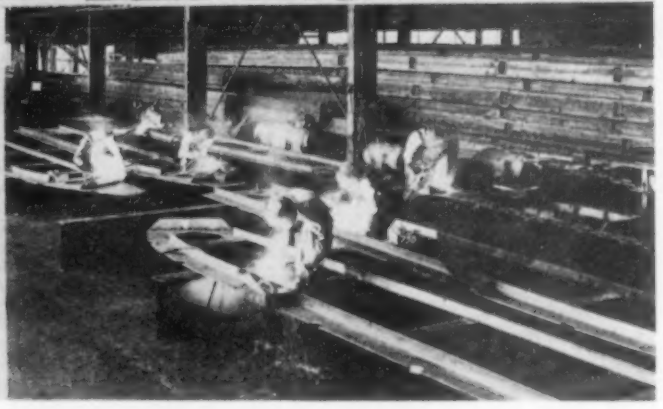


Fig. 21

Fig. 22

Fig. 19—Assembly Jig for Accurately Positioning and Tack Welding Stiffeners to Plate Sections of the Shaft Alley

Fig. 20—Stiffeners Are Fitted and Tack Welded to Deck and Bulkhead Plates in This Compressed-Air Hold-Down Jig

Fig. 21—Open Inner Bottom Floor Sections Being Assembled and Tack Welded on a Double Port and Starboard Jig

Fig. 22—A Welding Crew Continuous Downhand Welds Open Inner Bottom Floor Sections

Fig. 23—In This Department Pontoon Hatch Covers Are Assembled, Tacked and Continuous Welded

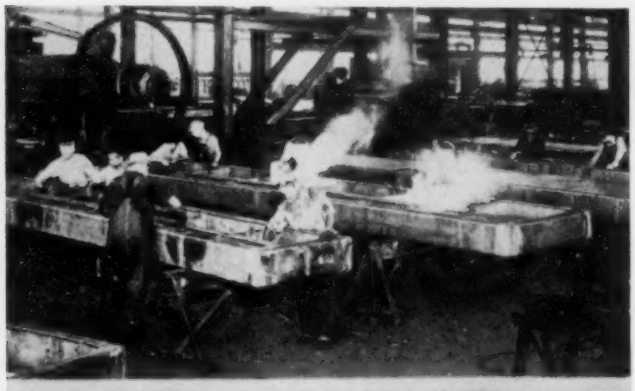


Fig. 24—Flame Cut and Formed, Primary Assembly, Subassembly and Complete Units Such as This Shaft Alley Section Are Shipped, on Completion, by Truck or Rail, as Shown, from the Birmingham Fabrication Plant to the Pascagoula Shipyard

cutting-table bays is shown in Fig. 7. Rails at each end deliver the plate or shapes from the layout bays while overhead bridge cranes, floor operated, quickly place them where they are wanted.

Wherever possible, use is made of the high-speed Style 45 cutting tips which provide 20 to 30% faster production than standard types. As seen in Fig. 8, we use two torches for the parallel cutting of deck beam stiffeners and two again in Fig. 9 for cutting the bevel and land along the edge of a bulkhead plate $^{5}/_{16}$ in. thick. A steel-covered asbestos heat guard plate protects this small Radiagraph from injury in its close proximity to the heat zone. Double bevels and land on the edge of a $^{3}/_{4}$-in. plate are shown in Fig. 10 being made with a 3-torch setup, while, in Fig. 11, parallel stiffener plates are also being cut accurately and quickly with 3 torches on a Radiagraph. The flanges of 16-in. channels may be observed being flame trimmed in Fig. 12. The Radiagraph travels on the horizontal web, guided by a side roller pressing against the flange side. A right angle adapter projects the cutting flames at the correct elevation for flange severance flush with the web. These channels, converted to deep L's, are used for main frames and the severed tapered flange scrap is used for strongbacking. Circular lightening holes are being flame cut in Fig. 13, the Radiagraph traveling in an arc swung from the hole center with a radius rod. The bilge ends of these floor sections are cut with the hand torch and a guide along the template line.

In these bays and at other departments where oxyacetylene cutting is conducted, oxygen and acetylene are supplied from regulator stations positioned on columns and dropped from the universal oxyacetylene pipe-line system overhead. A welded steel box frame affords protection against injury from crane-handled plates and shapes.

Departmentization

Every effort is made to maintain the complete flexibility of those departments which will serve for the production at intervals of different items or ones differently jigged. Most of these departments may be changed overnight, or in the same number of hours during the day to accommodate production line welding of the many diversified units proceeding through the plant in quantities sufficient for five ships. On the other hand, there are certain items upon which the production time is so geared that the same operation may be maintained continuously. An instance of this is the all-welded fabricated mooring bitts made in Birmingham, and a view of the department devoted to this operation is seen in Fig. 14. Cutting, fitting, tacking and welding positioner stations all follow in the proper sequence. A view of the Radiagraph trimming operation on the inverted bitt base is seen in Fig. 15 and the completed bitts, ready for shipment to our shipyard, are shown in Fig. 16.

Jigs and Positioners

Considerable time is, of course, saved by positioning as much of our work as is practical inasmuch as, fundamentally and economically, the best welding is done downhand or as close to it as possible. If properly designed, a positioner permits the employment of anchors which, along with the practice of skip welding, also described as "wandering," aids measurably in the prevention of distortion. The accessibility of the work as well as the ease of movement, reduces the time necessary for the production of each unit. Where sufficient production warrants a group of duplicate positioners for the same operation, the higher-rated welder time factor is again reduced because the setup prior to and knockdown after welding may be executed by lower-rated labor while the welders are engaged elsewhere.

Figures 17 and 18 are examples of some of the shop-made, all-welded, welding positioners constructed and in use at Birmingham. In the former we have a two-plane adjustment with a work face which will accommodate small hatch covers, doors, mast house sections and other flat primary assemblies of reasonable size. In Fig. 18 is seen a deep tank hatch cover, 14 x 11 ft., on a fixed angle positioner. Flanged beams, angle fairing, intercostals and cover are tacked horizontally on the platen; and then the unit is mounted on the positioner with the overhead bridge crane.

Accuracy of dimension and speed of assembly are attained likewise with the use of jigs wherever the work will lend itself to such treatment—as in the case of the shaft alley jig in Fig. 19. The stiffeners are formed at the furnace slab, fitted to the rolled plate sections and tacked. Tight fits of stiffeners to deck and bulkhead plates are obtained with the hold-down fixture illustrated in Fig. 20 which is carried the length of the steel platen devoted to this operation by a small gantry. It is operated by compressed air, the overarm being made from a structural work reamer.

Open inner bottom floor sections are assembled and tack welded horizontally in a long jig, see Fig. 21, which accommodates both the port and starboard sides, one at each end. The ends may be utilized separately or simultaneously. A gantry then carries them down the bay to the welding skids shown in Fig. 22 where a welding crew continuous welds the stiffeners to the bottom angle and serrated beam sections.

A secondary type of positioning, tiering, combined

with departmentization, is frequently employed. When like units, passing through a series of operations, are capable of being assembled in the one general location, then such are grouped in tiers as indicated in Fig. 23 in the instance of pontoon hatch covers. The cast covers, flanged cover plate, longitudinal beam and transverse bulkheads are fitted, tacked and welded at this one location.

And so, finally, all of these sections, primary assemblies and subassemblies as discussed and blower, pump, steering gear, steady bearing, boiler, condenser and mast pole foundations, small hatches, machine shop work desks, sea chests, steering gear flats, as well as numerous other small and medium size units, are passed onward to the ends of the bays. There they are inspected, painted and prepared for shipment to our Pascagoula yard by truck or, to a greater extent, by rail as in the case of the shaft alley in the gondola in Fig. 24.

Ordnance Flame Hardening*

By Stephen Smith†

THE tempo of modern warfare has increased to such a tremendous degree that mass production of ordnance material is mandatory for successful military operations. Speed is the primary factor for producing and delivering overwhelming quantities of armament to the critical area of military operations at the critical moment. To accomplish the feat of changing from peaceful production to military production with the greatest speed, every available newly developed industrial process and invention was utilized to the greatest advantage. During every emergency some means for coping with it can always be found.

When our country was suddenly plunged into the world conflict and immediate changeover to war economy was necessary, many new ideas and industrial processes under development were utilized to bring about the mass production of war materials.

Mechanized warfare on a global scale requires vast quantities of ordnance material which must be able to withstand terrific abuse of battle operation. Hence, the need for proper heat treatment of the metals used in all armament.

Peacetime heat-treating facilities, although completely converted, could not meet the overwhelming demands imposed upon them by wartime ordnance needs. Increasing these facilities to meet the demands would have involved considerable time and use of critical materials which were not readily available. Therefore, other means of overcoming the deficiency were inevitable. The answer was found in the new surface heat-treating processes, flame hardening and electric induction hardening, which had been in use and under further development for some time prior to Pearl Harbor. These processes afforded rapid and flexible means of heat treating, readily adaptable to production operations without the use of large quantities of scarce metals and with the minimum amount of floor space for heat-treating operations. The Army Ordnance Department recognized the value of the flame-hardening process and was prompt in accepting and approving the flame-hardening process for ordnance material.

This article will deal with the role flame hardening is playing in the production of ordnance materials.

Just a few months prior to this country's entry into the war, the flame-hardening process had been expanded by our development of a new technique, that of Simultaneous Hardening and Tempering, which was immediately utilized for ordnance heat treating, particularly on Army tank bogie wheel rims. This technique bridged a gap in the existing flame-hardening process which was limited to producing a surface hardness close to the maximum obtainable on the material under treatment. To obtain an intermediate or a lower hardness, the flame-hardened surface had to be subjected to a furnace drawing operation.

The simultaneous flame-hardening and tempering technique is applied using the progressive method of flame hardening. The material under treatment is progressively heated by a multiflame oxyacetylene burner, followed immediately by a quenching stream to produce surface hardness. The quenching stream is followed at a predetermined distance by a soft multiflame oxyacetylene burner which heats the hardened surface to a proper drawing temperature, which produces the desired intermediate surface hardness. This technique permits any surface to be completely flame hard-

Official OWI photo by Rittase

Fig. 1—M-4 Tank in Action

* Presented at the Annual Meeting, A.W.S., Chicago, Ill., Oct. 18 to 21, 1943.

† Development Engineer, Applied Engineering Dept., Air Reduction Sales Co.

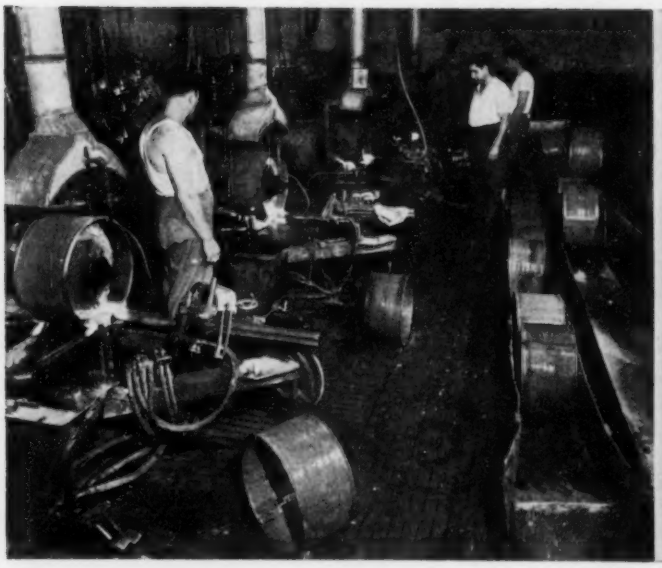


Fig. 2—A Battery of Production Machines at the Cleveland Welding Co., Cleveland, Flame-Hardening Tank Bogie Wheel Rims

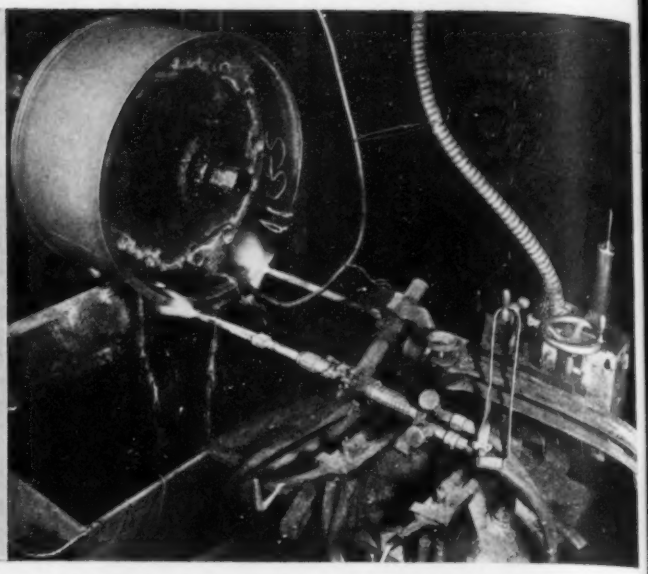


Fig. 3—Tank Bogie Wheel Rim Flanges Being Simultaneously Flame Hardened and Tempered in One Revolution of Rim

Torches on the other side of rim (not visible) harden and temper the other flange at the same time.

ened in one continuous operation to any desired degree of hardness without need for subsequent treatment by furnace or other means.

Army field tests revealed that the rim flanges of tank bogie wheels are subjected to considerable battering and crush from stones and other material becoming wedged between the tractor tread and these wheels when in operation, causing the rim flange to become dented and twisted. Hard rubber tires are molded to these bogie wheel rims, leaving only the flanges exposed to this battering. To resist this battering, it was necessary to strengthen these flanges. As only a medium hardness was desired, the newly developed simultaneous flame-hardening and tempering technique was promptly applied, and proved to be very successful. The production of this urgently needed item was thus initiated, using available standard oxyacetylene apparatus.

Figures 2 to 4 show how this process was used by the Cleveland Welding Co. on a production basis for hardening tank bogie wheel tire rim flanges. The rims are made of fine-grain Modified 1035 S.A.E. steel plate rolled to the proper section at the mill. After cutting to length, cold forming to circular form, flash welding, cold sizing the diameter and facing the sides to proper width, the rim is ready for flame hardening.

The initial hardness of the rolled plate as received from the mill is 150 to 160 Brinell. This is increased to 170 to 190 in the cold forming and sizing operation. Specifications require that both flanges of the rim be hardened to 287 to 360 Brinell.

Special machines were designed to flame harden and temper both rims simultaneously to this degree of hardness. A battery of five machines (Fig. 2) produce the desired daily output.

The rims are mounted manually on a compressed air expanding chuck which is foot-controlled by the operator. The chuck is located on a sliding table which is moved sideways out of the flame-hardening position by means of a hand lever. When chucked the rim is moved into hardening position and the torches are lighted. The wheels are rotated at the proper speed by an electric motor which drives the chuck. Two standard welding torches, one for heating and one for tempering, are mounted on each side of the wheel with standard heating tips directed at the rim flanges, thus hardening and tempering both flanges simultaneously at a speed of 8 in. per minute. A water quenching jet is located between the heating and drawing flames. The flame heating tips are extinguished after one revolution, and the rim continues to rotate until the starting point, which has been hardened by the quench, passes under the drawing tips, whereupon the rim is completely flame hardened and drawn in one simultaneous operation.

The completed rims are placed in an inclined cooling trough whence they proceed to the inspection bench where they are checked for hardness on a Brinell tester, also for diameter and width of face and height of flange. If eccentricity is revealed in checking the diameter, this is corrected by a cold sizing operation.

Larger wheel rims are flame hardened at the same plant. A single machine turns out the desired production. The machine consists of two shafts on which are located four sets of driving pulleys. The shafts are connected by a chain and are driven by an electric motor.

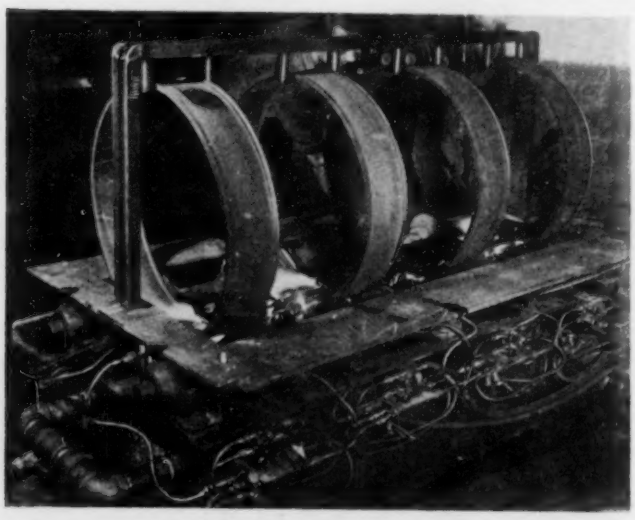


Fig. 4—Large Bogie Wheel Rims are Flame Hardened and Tempered Four at a Time in This Multiple Production Machine at the Cleveland Welding Co., Cleveland

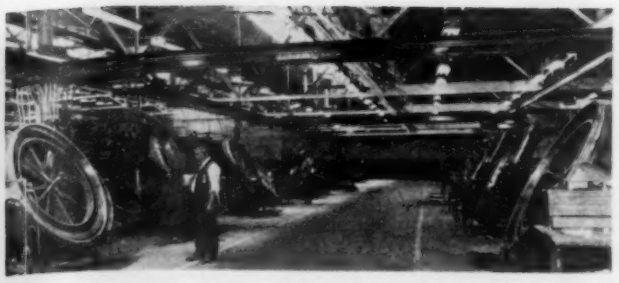


Fig. 5—View of the Oxyacetylene Flame-Hardening Department of the Fisher Tank Division, General Motors Corp., Flint, Mich., Showing Two Rows of Machines for the Production Flame Hardening of Army Tank Turret Ring Ball Bearing Race Surfaces

On each of the pulleys, rims to be flame hardened are mounted. The rims rest on the pulleys which rotate the rims at the proper speed past the flames. The flame-hardening and tempering tips are located at the bottom of the rim, one set on each side directed at the flanges, with a quenching jet between the heating and tempering flames. Both flanges are then hardened in one complete revolution, after which the rim is lifted from the pulleys and another mounted in place for hardening. The machine is built to harden four wheel rims at a time. The speed of hardening is 11 in. per minute or one rim in 8 mins. These may be hardened simultaneously, consecutively or in any order whatsoever. Any set of torches may be shut down without interfering with the remainder.

After the initial hardening speed and gas pressures to produce the desired depth and degree of hardness are determined, these are maintained and the operation produces uniformly hardened rims on a production basis with a very small percentage of rejects. When changes in material or hardness specification are made, corresponding changes in gas operating pressure are decided upon and the desired results obtained on a few rims, whereupon the operation proceeds in production under the new conditions. Thus changes in operation may be effected in a short time without delaying and holding up production.

Flame Hardening Tank Turret Rings

Another ordnance problem was that of insuring long life and freedom from failure of tank turrets. Each turret is composed of ball bearing rings which, when assembled, permit the turret to swing freely and permit the turret gun to fire through an arc of 360°. The turret ring races were specified to be hardened. It was virtually impossible to handle the large volume of rings involved in all the heat-treating furnaces available. Moreover, the physical properties of the heat-treated rings made it difficult to machine them after hardening. Heat treating after machining would distort the rings to such an extent that straightening would be difficult, costly, time consuming and often impossible. To meet the specifications, flame hardening was decided upon as the most practical and quickest method of heat treating these races on a production basis.

Each ball bearing race surface, three of which comprise the assembled turret ring, is flame hardened to a uniform depth and hardness. At the plant of the Fisher Tank Division of General Motors, the initial races, flame hardened after finish machining, showed negligible distortion and did not require further machining or grinding operations. In fact no development work was necessary to put the job on a production basis. The first rings machined were urgently needed for the initial tank coming off the production line and no turret rings were available for experimental hardening to check hardening speed and depth of hardness. Proper technique permitted speeds and pressures to be set correctly on the initial operation and the rings were flame hardened satisfactorily and assembled on the first tank without difficulty. The work was coordinated and timed on the assumption that no appreciable distortion of the rings would result from the flame-hardening operation. Results obtained showed this to be true, and therefore what might have proved to be a difficult heat-treating problem and a bottleneck in the production line was averted.

Figures 5 to 7 show the flame-hardening department at the Fisher Tank Division and close-up views of the flame-hardening operation on race surfaces. The jigs are

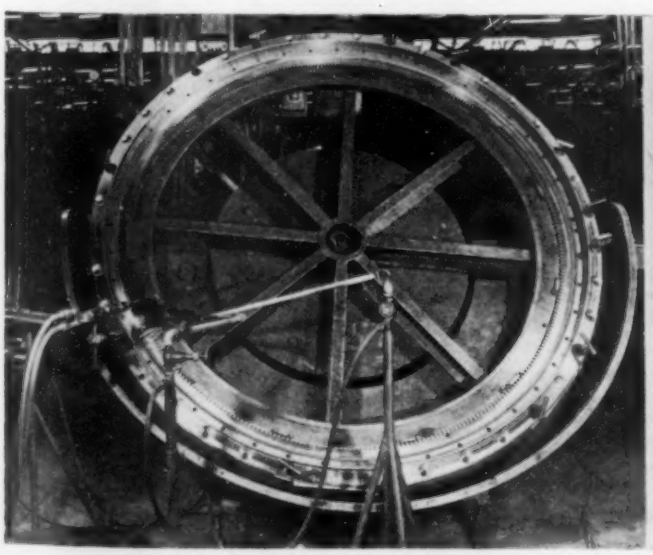


Fig. 6—Flame Hardening One of the Tank-Turret Ring Race Surfaces

A heat-treating torch with a multiple burner specially designed to uniformly heat the race surface is used to harden the ring progressively in one revolution to a uniform depth and degree of hardness.

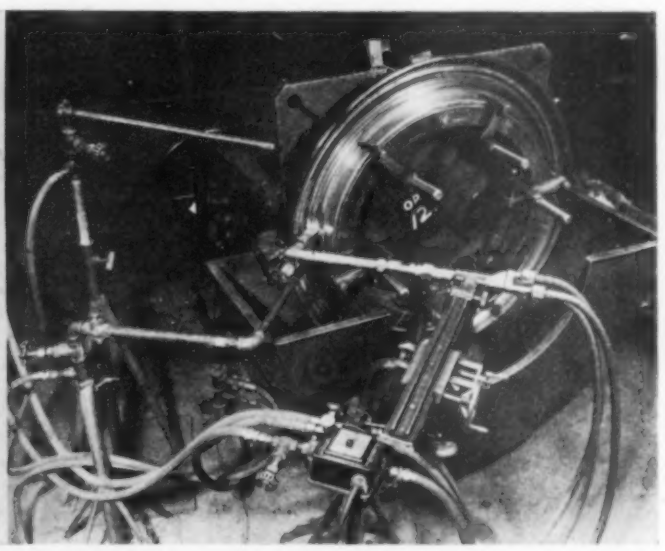


Fig. 7—Flame Hardening the Race Surface of a Tank Turret Revolving Manhole Casting

The torch and auxiliary quenching jets are mounted on adjustable stands which can be readily swung out of position for changing castings on the machine.

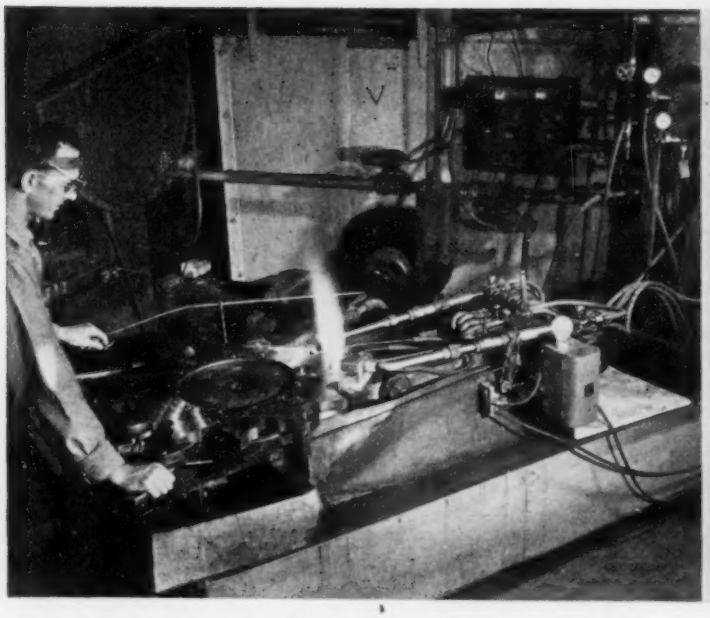


Fig. 8—Tank Driving Sprockets Are Flame Hardened by the Spot-Hardening Method at the Eaton Mfg. Co., Detroit

This semi-automatic machine using two contour-shaped special burners hardens a 13-tooth sprocket in 10 min. Heating time per tooth is 40 sec.

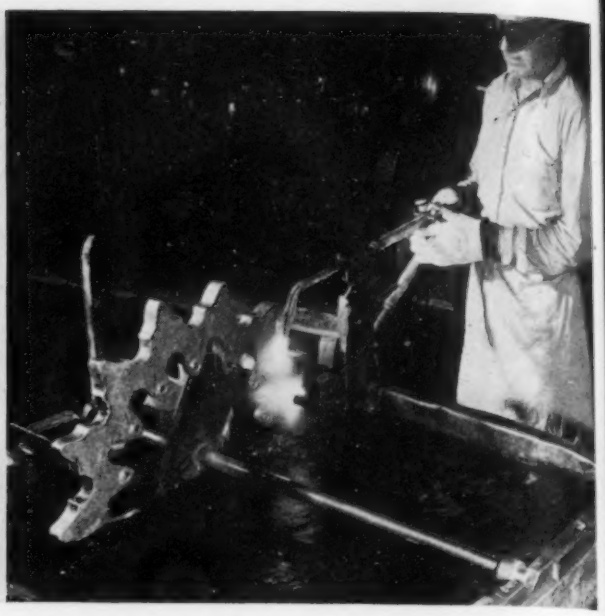


Fig. 9—Manual Spot Flame Hardening Is One of the Methods Employed at the Plant of the S. M. Howes, Inc., Taunton, Mass., for Hardening Tank Sprockets

After each tooth surface is heated to the required depth, the sprocket is rotated and the heated tooth is quenched in the circulating water bath.

mounted on a welding positioner with a rotating table which is provided with a variable adjustment to give the proper hardening speed for each particular size of ring. The jigs are inclined at a sharp angle of approximately 60° for ease of loading and unloading and for disposition of the quenching water. By this arrangement the ring may be completely cooled or partially cooled to leave residual heat, which may be required on some steels. This flexibility was found advantageous when a change was made in the material from which the rings are made.

Special multiflame burners were designed for each ring to uniformly heat the race surface contour, followed by water quenching jets for hardening. The torches are mounted on portable stands in front of each machine (Figs. 5 and 7) and are clamped in an adjustable arm equipped with all the necessary adjustments to effect proper positioning of the burners for uniform heating. The rings revolve past the burners which uniformly heat and quench the race surface to the proper depth and degree of hardness. The various rings are hardened at surface speeds of from $7\frac{1}{2}$ to 9 in. per minute in one complete revolution. Total hardening time ranges from 18 to 40 min. per ring depending on its size. Uniform depth and degree of hardness are closely controlled by maintaining constant acetylene and oxygen pressures.

One man operates two flame-hardening machines loading and unloading rings with an electric hoist. After flame hardening, rings are periodically tested for hardness with a Shore Scleroscope tester in a special testing fixture which holds the various sizes of rings. They are then taken to the assembly bench and the races comprising a complete turret ring are assembled with ball bearings and bolted together. They are then ready to be assembled into a tank.

Small diameter rings for the tank turret revolving manhole cover are flame hardened in a similar manner, as shown in Fig. 7.

Flame Hardening Tank Sprockets

Army field tests also proved the advantages of flame-hardened tank drive sprockets over unhardened sprockets, with the result that all tank sprockets are now specified to be flame hardened. These sprockets are either oxyacetylene flame cut from rolled plate or made of cast steel. The length of service of a flame-hardened sprocket is three to four times that of an unhardened sprocket. Various techniques are used in the production flame hardening of sprockets.

At the Eaton Manufacturing Co. plant in Detroit, sprockets are flame cut from rolled plate. Annealing follows flame cutting, after which the sprockets are completely machined to finished dimensions including the tooth contour. Flame hardening is the final operation.

Figure 8 shows the flame hardening setup at this plant. Sprockets are flame hardened by the spot-hardening method in a semi-automatic machine. The sprocket is mounted horizontally on a turntable. Two heat-treating torches with special multiflame burners are mounted on a movable carriage and are positioned to heat both sides of a sprocket tooth. The heating cycle is 40 sec. The sprocket is indexed by a manually operated lever which moves the torches away from the sprocket and brings the next tooth into position for heating. As the next tooth is being heated the preceding heated tooth is quenched by a water spray mounted on the torch carriage. Thus, the quenching operation is simultaneous with the heating operation. An electric timer activated by a push button, lights an electric bulb and rings a bell when the heating cycle is completed. This signals the operator to index to the next tooth. After heating the last tooth, the burners are extinguished manually by closing an oxyacetylene gas control valve and the tooth is indexed to the final quenching position, completing the hardening of the sprocket. The sprocket is then manually removed from the machine and another is placed on the turntable for hardening.

Uniform heating and quenching are assured by positive positioning of each tooth with relation to burners. With the arrangement shown a complete sprocket is hardened in 10 min., or $4\frac{1}{2}$ per hour. Greater production may be obtained with multiple burner units heating two or more teeth simultaneously.

Inspection procedure consists of periodically checking the depth and degree of hardness. Visual observation of the heat line gives a close check on the depth of hardness. This is periodically supplemented by shot-blasting the tooth surface to reveal the depth of hardened area. Extreme uniformity of hardness is insured by close control of the oxyacetylene gas pressures. Consistent results with no distortion produce few rejects from flame hardening.

Another plant, the S. M. Howes Inc., Taunton, Mass., produces flame-hardened cast steel sprockets. These are cast under close supervision, heat treated to specific physical properties, completely machined and then flame hardened. Two spot flame-hardening methods are used at this plant, a manual (Fig. 9) and a semi-automatic operation (Fig. 10). The sprocket has 13 teeth and is made of 0.40 carbon steel.

Manual Flame Hardening Operation

A sprocket is mounted on a mandrel which is placed in grooved bearings of a quench tank. Half of the sprocket is immersed in a circulating water bath. Two standard welding torches with two-flame tips are used for heating. The torches are hinged together at their rear ends and provided with rollers attached to each tip shank, as shown in Fig. 9. The rollers are inserted into a female cam mounted on the side of the tank. The cam is shaped to proper contour to guide both tips along the sprocket tooth contour. The heating is performed by manually moving the torches back and forth in the cam. Heating time per tooth is 45 sec. After a tooth is heated, it is immersed into the circulating bath, and the next tooth is then brought into place for heating. This is repeated until all teeth are hardened. One complete sprocket is flame hardened in 11 min. A helper is employed to mount sprocket on mandrel, lift into tank and index teeth during the hardening operation. An operator can become highly proficient with the result that this manual operation will produce flame-hardened sprockets equivalent to, and in some cases superior to sprockets flame hardened by a fully automatic machine.

Mechanical Setup

A sprocket is mounted horizontally on a freely rotating table set in the center of a steel tank (Fig. 10). Two heat-treating torches and a quenching jet are mounted horizontally on a shaft placed at one end of the tank. Two special multiflame sprocket heating tips are positioned to fit the contour of one tooth, centrally located. A quenching jet shaped to the contour of the teeth is positioned to quench the second tooth ahead of the one being heated. A lever attached to one end of the shaft permits the operator to raise torches and quench to an angular position while sprocket is being indexed to next tooth. A city gas pilot light positioned between the two tips is used to ignite the gas.

The tips are lowered to the horizontal position for heating a tooth, applying heat for 45 sec., after which the operator raises the torches and indexes the sprocket to bring another tooth into position. He immediately lowers the torches into position, and heating of the fresh tooth begins while the first is being quenched. The apparatus is so mounted that when the torches are lowered to heat the second tooth, the quench jet is also lowered and brought into position for quenching first tooth. Every tooth is indexed by a manually operated indexing bar which is brought up to a stop. After the last tooth has been heated, the tips are extinguished by means of two gas control valves and the heated tooth is indexed into the quench. At completion of quenching, the sprocket is lifted from the table and another mounted in place for hardening. A centrifugal pump is used to pump water to the quenching jet.

Inspection

Every completed sprocket is inspected for general appearance of casting, hardness of flame-hardened sprocket teeth, sprocket tooth contour, tooth thickness, diameter of machined recess, mounting lug hole spacing and an inspection for side runout checks the casting for distortion. Tooth hardness specification is 72–82 Scleroscope or 550–600 Brinell.

Flame Hardening Army Tank Tractor Tread Grousers

Because of the shortage of rubber and other reasons, a great percentage of Army tank tractor treads are being made of steel to reduce the wear. To increase the life of the steel grouser, which is the name given to one section of the tread, Army Engineers conducted tests on flame-hardened grousers. The tests revealed that flame

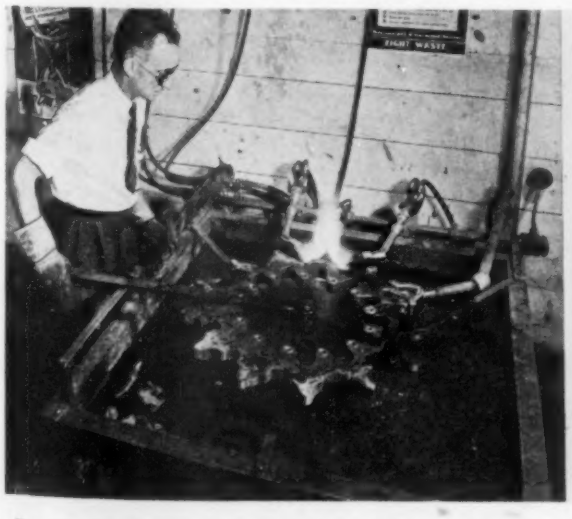


Fig. 10—Mechanical Setup for Flame Hardening Tank Sprockets at S. M. Howes, Inc.

Each tooth is heated by two multiflame burners for 45 sec. Spray quenching follows indexing and is simultaneous with the heating of the next tooth.

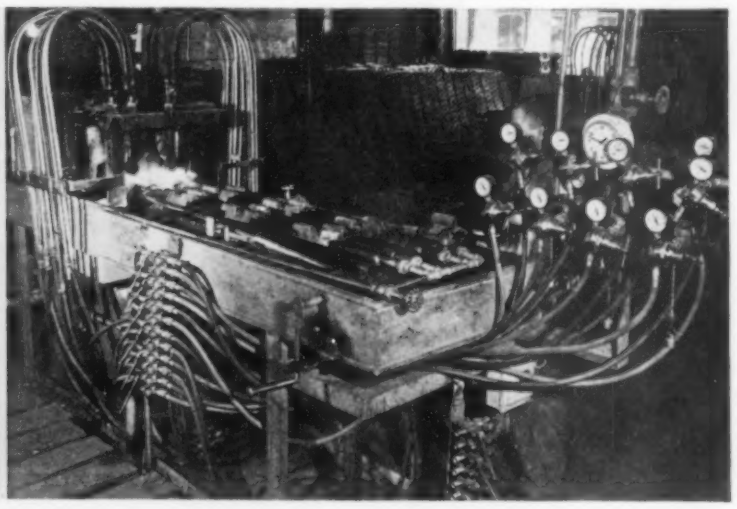


Fig. 11—Cast Steel Army Tank Tread Grousers are Spot Flame Hardened on a Production Basis on This Machine at the Connelly Metal Treating Co., Cuyahoga Falls, Ohio

The machine's production rate is 120 per hour.

hardening greatly increased the life of a grouser, and accordingly, ordnance specifications now require all steel grousers to be hardened. The heat treating of steel grousers is one of the largest volume flame-hardening production operations in the country. Each tank requires 158 of these tread sections.

At the Connelly Metal Treating Co., Cuyahoga Falls, Ohio, thousands upon thousands of grousers of various shapes and sizes are flame hardened on a production basis by the spot-hardening method (Figs. 11, 12 and 13).

Fig. 12—Eight Carriage-Mounted Burners, Four per Grouser, Move Back and Forth Over the Grouser Surfaces, Heating to a Depth of 1/4 In. in 50 Sec.

The grousers are moved under a spray quench behind the burners for hardening.

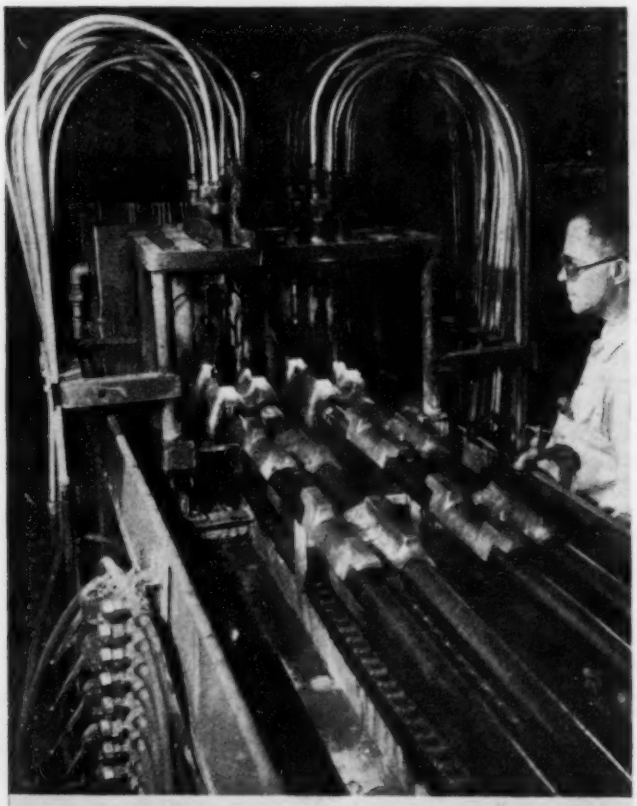


Fig. 13—Pile of Flame-Hardened and Unhardened Tank Tread Castings at the Connelly Metal Treating Co., Awaiting Disposition

This picture gives an idea of the tremendous number of these castings being flame hardened.

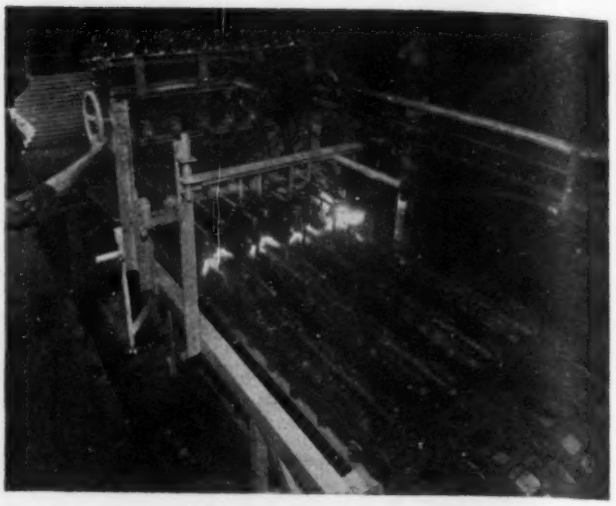


Fig. 14—Cast-Steel Tank Tread Grousers Are Flame Hardened by the Progressive Method at the Plant of Trinler Inc., Chattanooga, Tenn.

The castings are fed at uniform speed under eight burners on a four-track endless conveyor, and are flame hardened to 1/4 in. depth at a speed of 6 in. per minute.

Three specially designed production hardening machines are used in flame hardening the grousers. Two grousers at a time are hardened on each machine. Two sets of heat-treating torches, three or four per set depending on size of grouser, with standard multiflame oxyacetylene burners, are mounted on a carriage and positioned to heat the surfaces of the grousers. The grousers are fed manually into position under the burners on two conveying lines. The burners are moved back and forth over the length of the grouser surface, heating the entire surface to a depth of 1/4 in. Heating time is 50 sec. An electric timer notifies the operator when heating is completed, and the heated grouser is then moved into a quenching spray, thus hardening the surfaces. At the same time another grouser is moved into heating position. This is a continuous production operation, one operator loading the machine and feeding the grousers into the heating and quenching positions, after which they drop into a receptacle and are removed by a helper. Production is 120 grousers per hour per machine. Torches and tips are completely water cooled to withstand the intense heat of the operation. Periodic inspection is made for depth of hardness by cutting a casting in two and etching to reveal the hardened zone. Hardness inspection is made on a Brinell hardness machine. Grousers are hardened to 550–600 Brinell.

Another company, Trinler, Inc., Chattanooga, Tenn., flame hardens cast steel grousers by the progressive method on a special flame-hardening machine (Fig. 14). Four endless chain conveyor tracks are used. Eight heat-treating torches are mounted stationary on the machine, two for each conveyor line. Standard oxyacetylene multiflame burners having integral quenching jets to the rear of the heating flames are employed. The castings are manually loaded on all four conveyors which turn continuously in unison. The castings travel at a uniform speed underneath the burners where the grouser surfaces are progressively heated and quenched at a speed of 6 in. per minute. The hardened castings travel to the end of the machine where they slide onto another conveyor which carries them away. Two machine operators, one at each side of the machine, manually operate cams which control the burners for two conveyor tracks. The cams control the oxyacetylene gas to the burners, which are lighted and extin-

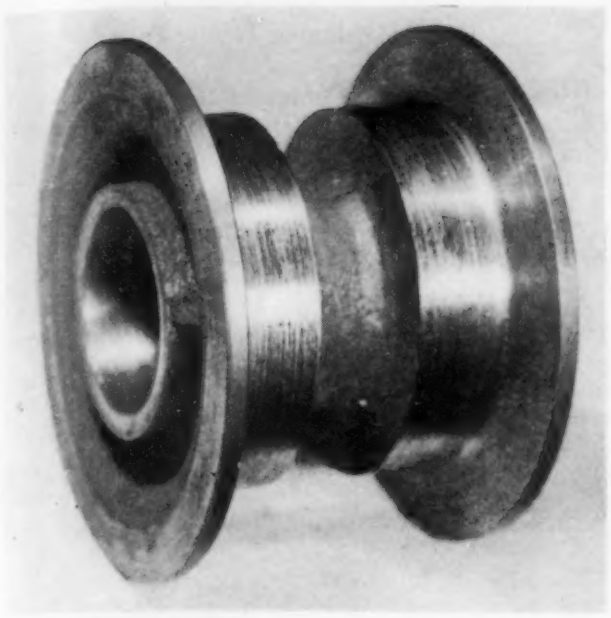


Fig. 15—The Two Flanges and Tread Surfaces of This Caterpillar Tractor Roller Hub for Army Air Corps Bulldozer Tractors Are Flame Hardened in Production at the Clark Equipment Co., Buchanan, Mich.

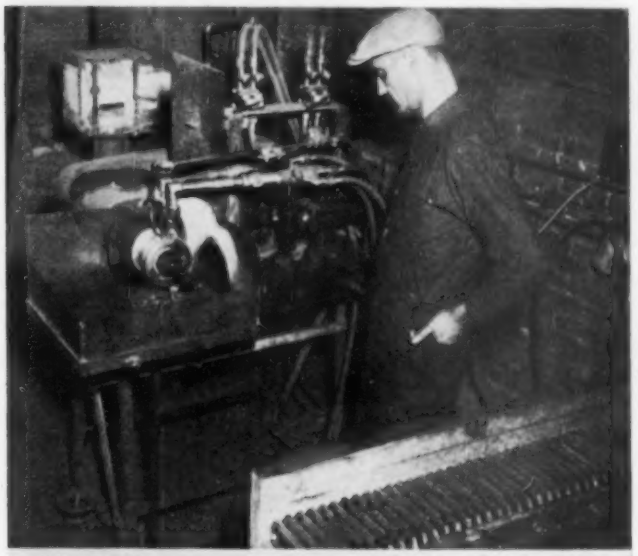
guished as the surfaces to be hardened pass under each burner.

The torches are completely water cooled to withstand the intense heat of the operation, while the burners are cooled by the flow of the integral water quenching stream behind the heating flames. Natural gas-heating jets are mounted ahead of the burners to preheat the castings, thereby speeding up the operation.

One man at the front end of the machine continuously loads castings onto the conveyor. Production from four

Fig. 16—This Small Machine Flame Hardens 25 Tractor Roller Hubs per Hour by the Progressive Method at the Clark Equipment Co.

The rollers rotate past two multiflame burners, each hardening two surfaces simultaneously. All four surfaces are hardened in one revolution of the roller hub.



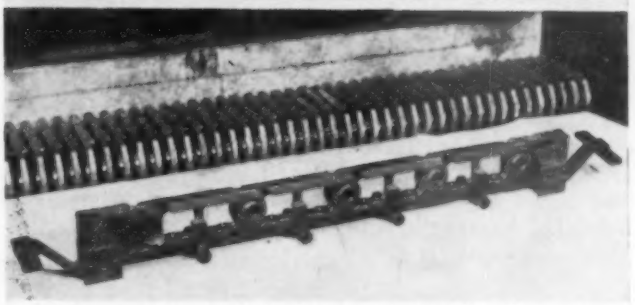


Fig. 17—Four Tractor Link Castings Are Held in This Fixture for Flame Hardening the Link Surfaces

The links are submerged in a water bath with water level above the machined holes to prevent the holes from distorting.

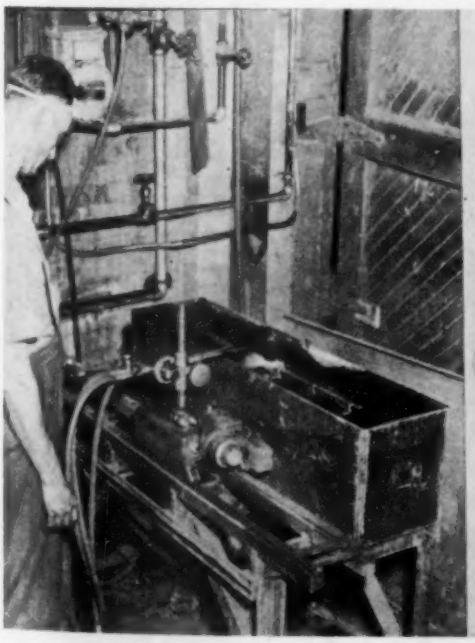


Fig. 18—One Hundred Links per Hour Are Flame Hardened with This Setup

The radiagraph propels the multiflame burner over the surface of the links at a speed of 13 in. per minute and hardens surface to a depth of 1/8 in., Clark Equipment Co., Buchanan, Mich.

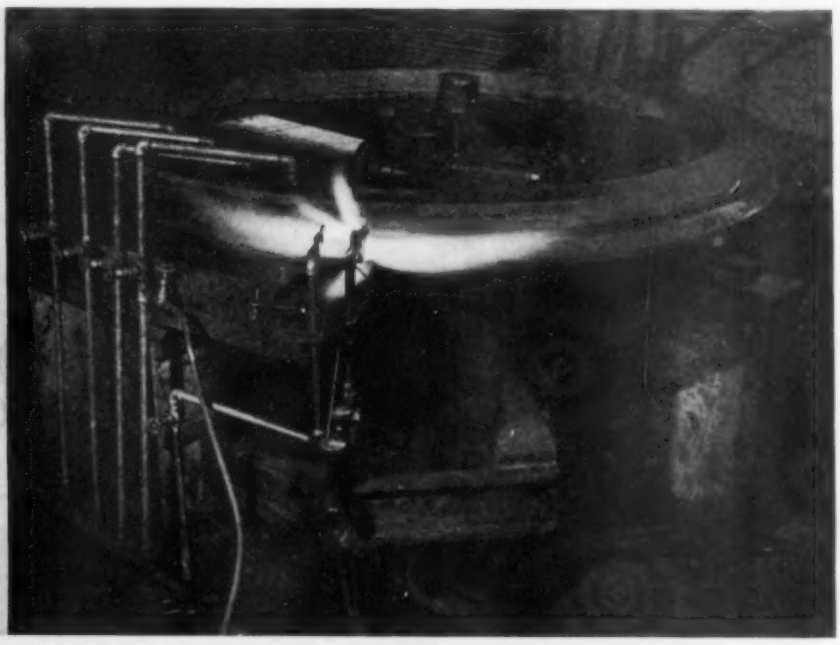


Fig. 19—Race Surfaces of This 8-Ft. Roller Bearing Ring Were Progressively Hardened in 1 Hr. 17 Min. as the Ring Rotated Past the Specially Designed Multiflame Oxyacetylene Burner, Messinger Bearing Co., Philadelphia, Pa.

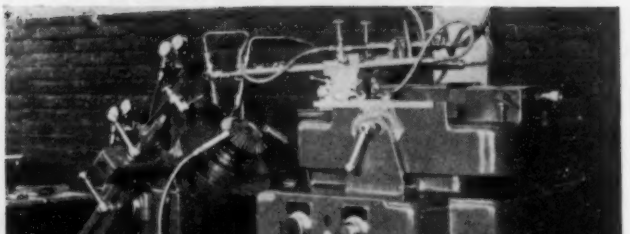


Fig. 20—Hardening Tooth Surfaces on a Gun Mount Gear, Using a Gleason Automatic Gear Hardening Machine

The hardened gear offers much greater resistance to severe service batter than an unhardened gear.

conveyor tracks is 120 per hour. The hardened castings are periodically tested for depth and degree of hardness. Specifications call for minimum of $^1/_4$ depth and 475 Brinell. Average hardness secured is 550 Brinell.

Flame Hardening Tractor Parts

Production flame hardening of tractor parts such as tractor roller hubs (Fig. 15) and tractor links (Fig. 17) is being done at the plant of The Clark Equipment Co., Buchanan, Mich. These parts are for bulldozer tractors for the Army Air Corps. The heat-treating and machining problems involved in the manufacture of these parts necessitated that they be flame hardened.

The tractor roller hubs, twelve of which are required for each tractor, are hardened in a special machine (Fig. 16). The rollers are mounted in a motor-driven, spring-loaded chuck and rotated at a surface speed of 6 in. per minute past two multiflame burners. Each burner progressively hardens the flange and tread faces of the roller in one complete revolution. The spring chuck permits quick loading and unloading. Torches are extinguished at the completion of the hardening operation. With this setup, 20 rollers are flame hardened per hour.

The tractor link surfaces are progressively flame hardened by mounting four links in a special holding fixture (Fig. 17) and submerging them in a water tank with the water level slightly above the machined holes to prevent their distortion. A standard Radiagraph is used to propel the oxyacetylene torch over the links (Fig. 18). The surfaces of the links are progressively flame treated at a speed of 13 in. per minute, hardening the steel to a depth of $^1/_8$ in. and a Rockwell hardness of 55 to 60. Two rack fixtures are employed one being reloaded while the other is being used in the hardening operation. The holding clamps are of a spring-loaded type, which facilitate quick loading and unloading of the links. Production with this setup is 25 pieces per hour.

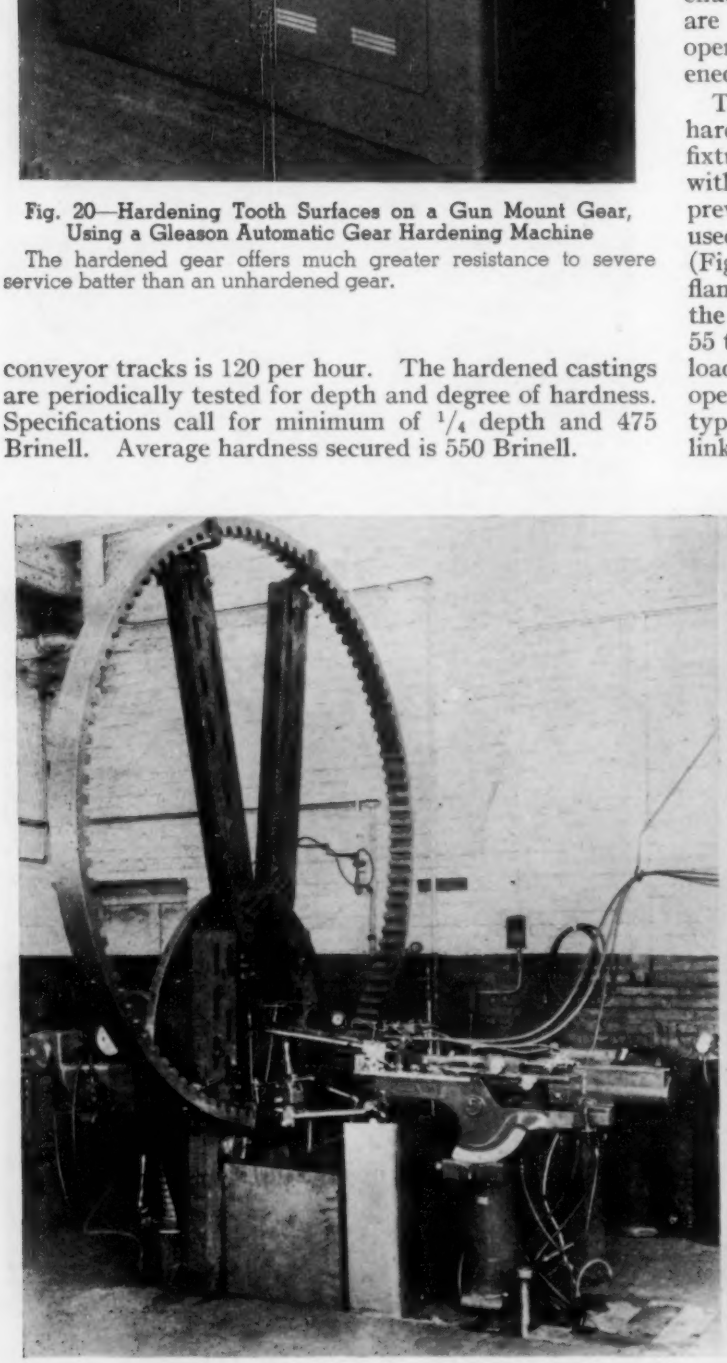


Fig. 21—Hardening Teeth on a Large-Diameter Internal Gear, Destined for Service as the Training Circle Gear on a Dual Purpose Gun

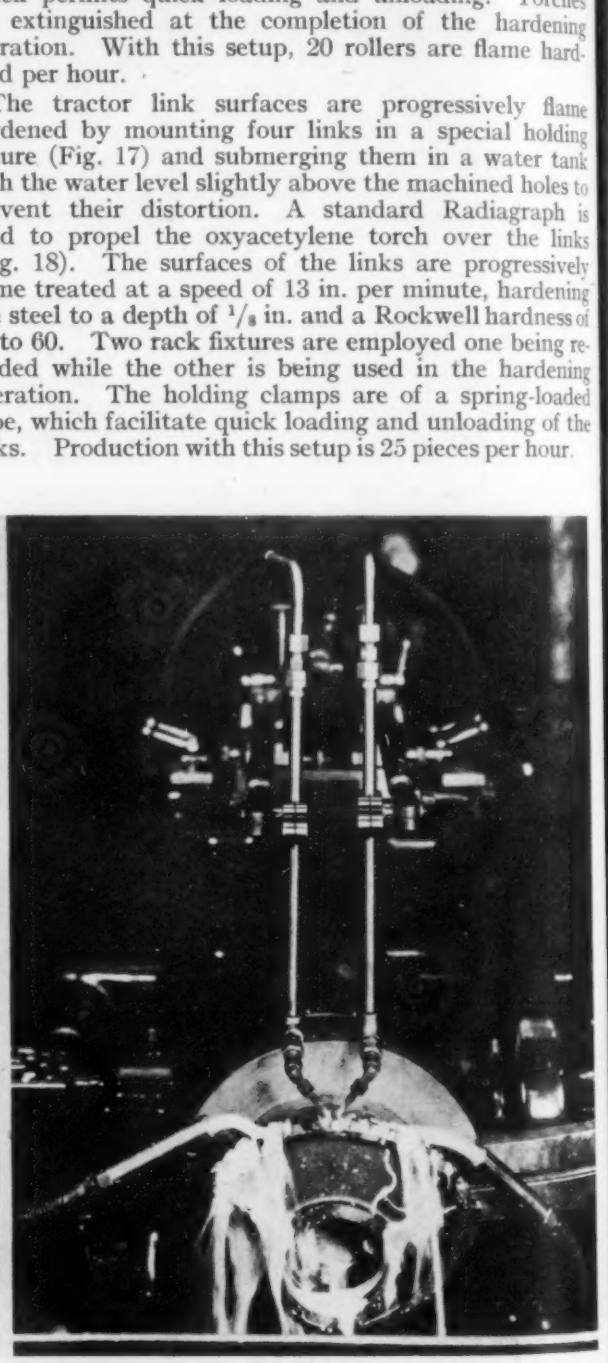


Fig. 22—Close-up of the Heating and Quenching Apparatus on a Gear Hardening Machine, in Action on a Landing Gear Retraction Segment for Military Aircraft

Bearing Races

A difficult heat-treating job was solved by application of flame hardening at the Messinger Bearing Co., Philadelphia, Pa. Inner and outer races of a large bearing, 8 ft. in diameter at the race surfaces, had to be hardened, and the parts were too large to be heat treated in available furnaces.

Although this job is not directly an ordnance part, the bearing is a base for a "manipulator" which is a machine for handling large forgings and ingots in and out of furnaces used for heat-treating ordnance parts. The bearings are made of an air-hardening steel and a minimum Brinell hardness of 450 was desired on the bearing surfaces.

Figure 19 shows the setup with the inner ring in position for flame hardening. The ring was supported and rotated on a number of ball bearings and was confined to rotate in a true circle by ball bearings around the outer circumference. A special internal gear rack, attached to the inner diameter of the ring, rotated it past the flame-hardening burner, being actuated by a motor-driven variable speed hydraulic reduction unit. A standard heat-treating torch with a specially designed water-cooled multiflame burner was mounted in an adjustable arm on a stand. As the steel was air hardening, no direct quench was used following the flames. The burner progressively heated the race surface and the hardening was effected by the quenching action of the mass of metal. However, a number of auxiliary quenching streams cooled the mass of the ring to dissipate heat from the ring as rapidly as possible. The race surface was hardened with one complete revolution of the ring in 1 hr. and 17 min. A hardness of 560 Brinell was attained. The distortion was negligible and a great deal less than would have occurred in furnace hardening. The outer race was hardened in a similar manner and both race surfaces were finish ground after flame hardening.

Gear Teeth

A very important factor in the ordnance flame-hardening picture is the hardening of gear teeth. In the case of gears, unlike most of the jobs already described, standard machines are available to harden teeth of any shape, on gears of any size. These machines are completely automatic, incorporating mechanical controls which assure positive uniformity of hardening of teeth on spur gears, straight, zerol and spiral bevel gears, and hypoid, helical and internal gears. The machine shown in Fig. 20, for example, set up for hardening a gun mount gear, has a working head which automatically speeds up when approaching the end of a tooth, to maintain uniform heating, then reverses at high speed to preheat the next tooth to be hardened.

A giant internal gear is shown in process of being hardened in Fig. 21. This is the training circle gear for rotating a fairly large caliber dual purpose gun. In hardening the teeth a standard Gleason machine is used, with a special setup for supporting and rotating the gear. The machine travels the oxyacetylene heating tips along the length of each tooth, while the self-contained quench imparts the desired degree of hardness. This process leaves no appreciable stresses between the hardened surface metal and the relatively ductile core. It is customary to heat treat a gear to the desired core condition while it is still in a rough or partially machined state, then machining, leaving the flame-hardening operation to the last. In gear manufacture this sequence represents a substantial saving, since machining of fully heat-treated and hardened gears is extremely costly and does not always result in satisfactory finish and accuracy.

A close-up of the heating and quenching apparatus of a gear hardening machine, set up with small tips for hardening an aircraft landing gear retraction segment is shown in Fig. 22. Other types of gears and similar parts hardened automatically are accessory drives on aircraft engines, Diesel engine pump and timing gears, heavy duty clutches for marine use and radial splines on split crankshafts for aircraft engines. Since gears enter into the fabrication of almost all heavy ordnance matériel, the role of gear hardening machines in war production is evident.

The foregoing are a few of the ordnance production heat-treating problems which are being done by the flame-hardening process. There are many others including Navy Ordnance jobs which because of their confidential nature cannot be revealed at the present time. The flame-hardening process is firmly established as an economical production tool. Rapid results can be obtained by the process with a minimum of time and equipment.

Inspection of Welded Structures*

By R. B. Lincoln†

THIS symposium on Inspection of Welded Structures should set forth the experience of a number of members and visitors, and for that reason my remarks will be brief and somewhat of an outline of the subject.

The need of inspection is generally recognized, and in cities that have building codes covering welded structures, it is generally mandatory. There are two considerations that have a large part in determining the type of inspection required in any operation whether it is welding or anything else. First is the percentage of failures that can be permitted. To use an illustration, if one should occasionally find an electrode with incomplete coating it can be discarded with little loss. Inspection is concerned in that case in keeping the percentage of defective electrodes low. With welded buildings we cannot afford to have any failures, or at least any that could be avoided with proper inspection. On this basis thorough inspection is justified.

The second consideration that I think determines the necessity for inspection is the factor of safety. If it is abnormally large, we can accept a defective part as long as the defect does not bring the factor of safety below normal. Some years ago it was a common practice to call for double the calculated amount of welding as a safety measure. In one case the welder himself wanted to put on considerably more welding than called for on the drawing and investigation showed that the designer

* Presented at the Annual Meeting, A.W.S., Chicago Ill.; Oct. 18 to 21, 1943.
† Director, National Weld Testing Bureau, Pittsburgh Testing Laboratory.

had called for twice the calculated amount of welding and that the detailer had further increased that.

Experience has shown that it is cheaper and at the same time safer to have suitable inspection with adequate but not excessive weld sizes. In fact there are cases where adding unauthorized welds might actually decrease the safety. This applies particularly to end connections in semi-rigid beam construction.

If a beam is supported at both ends with a pin joint, the joint carries a shear load only, the friction of the pin being very small. Pin joints are not ordinarily used at the end of beams in building. The joint must be either flexible enough to permit the rotation of the end of the beam due to deflection without overstressing any part of the joint, or it must be strong enough to prevent or partially prevent rotation without overstress. Generally the thoughtless addition of welding to a weld-designed semi-rigid beam connection is likely to decrease its safety.

One of the first steps in the proper inspection of a welded steel structure consists in having a suitable code or specification that is in effect part of the "invitation to bid." The contractor will then know what is required of him in quality and quantity of welding, qualification test and inspection. I believe that the AMERICAN WELDING SOCIETY'S Building Code and their Bridge Specifications are particularly well suited to this task. There is a great advantage in having uniformity of rules in different parts of the country so that all parties may easily become familiar with the procedure and so that one set of qualification tests may be used for all jobs. The Society's Code and Specification represent, I believe, the most generally accepted standard, and experience has shown them to be safe and workable. It is to be hoped that cities and all other governing bodies will make use of them as far as possible. If this paper can do anything to promote uniformity in codes and specifications, it will be worth while.

Proper qualification tests are a vital part of inspection. I will not go into the details of the tests but it is important that a written report be available that properly identifies the operator either by photograph, a signature or both and that the report give all the data required by the inspector to determine whether the test complies with the requirement of the job at hand. Unfortunately it is not possible to devise an inexpensive test that will show an operator to be qualified to do all kinds of welding, and if such a test were used few operators would be able to pass it.

A qualification test is not a perfect means of separating the competent from the incompetent. It is subject to the chance variations of any examination, but experience has shown the standard qualification test to be a practical and satisfactory procedure. A good welder may sometimes fail due to a relatively small defect at a critical point but he will never produce a really bad weld, and a poor welder has little chance of getting by. Where we are testing a small number of welds to qualify a man to work for months or years we are justified in placing the standard high enough to exclude the incompetent. The few good welders that fail can be retested.

Experience has shown that if a welder has the skill to make a good weld, we have little difficulty in getting good welds on the job. The unusual man who can make a good weld but actually does not do so, is soon discovered and eliminated. In my opinion qualification tests are very important and should not be neglected.

The kind of inspection required will differ with the kind of structure. In the case of a multi-story building, a bridge or any other structure where a weld failure would have serious consequences, I favor continuous inspection by competent men to determine the quality of welding by observing the operation through a hand shield. The inspector should go from operator to operator, keeping the entire job under observation. He should have a print showing the size and location of welds. In addition to observing the welds while they are being deposited he should inspect every weld for size and appearance after it is finished, and mark both the weld and print to show that it has been accepted.

The welding operator should also mark his welds except in cases where there are only a few operators and their work can be easily identified. These marks need not be permanant. Crayon may be used but many prefer steel stencils or a code of dots made with the welding electrode.

In the case of a single-story building or any other structure where the failure of a weld would not be serious, and could easily be repaired, I believe that continuous inspection is not usually required. One of the important functions of the inspector here is to see that welds are of the specified size and that none are omitted. A missing rivet could easily be detected by the open rivet hole but a missing weld can only be detected by carefully following the plans. Experience shows that this is an important point, and that it is not unusual for the inspector to discover that one or more welds have been omitted. I consider it important to mark accepted welds on a blueprint so as to discover omission. All welding inspection should be completed before the steel is painted.

One can form a fairly accurate opinion as to the skill of a welder by examining a finished weld. The skilled man will produce a fairly smooth weld with a regular pattern to the surface and show few starts and stops. Some opinion may be formed as to whether complete fusion of the weld into the parent metal is secured particularly in single-layer welds with the craters left unfilled, but there is a good deal of uncertainty as to fusion. Sometimes it is necessary to get reliable information as to the penetration of welds that have been completed without an inspector being at hand. The hole saw or trepanning tool is convenient in this case. A sample is cut from the weld, ground to a reasonably smooth surface and etched in acid. This clearly reveals the penetration or lack of it. I like to etch the sample in the field using about one-fourth nitric acid and three-fourth water in a drinking glass or wide-mouthed bottle. In this way, additional specimens can be taken if one shows objectionable defects.

Gamma-ray photographs offer another means of investigating completed welds. The entire equipment can be transported in a passenger car and set up practically any place on a steel structure. Generally gamma-ray inspection of structural welds is not justified if there is adequate inspection during welding but it supplies the needed information in important cases where this has not been done.

Let's Streamline Our Welding Schools*

By Clayton B. Herrick†

THE pressure is still on, so far as the war production picture is concerned, and when it comes to training welding operators the pressure is greater than ever. Experienced welders are going into the service every day and their places must be taken by hurriedly trained men and women who previously have had no education even remotely connected with welding. It is more essential than ever that students be taught in the least possible number of hours, and that they be given a thorough practical course which will equip them to step into the shop or yard as valuable workers.

There have been many papers written and several courses suggested in connection with the training of arc-welding operators but there still exists a crying need for improvement in methods of teaching and in courses given. Too many schools are spending much more time than necessary—in some cases twice as much—for their training program. In too many shops and yards the new welders are not prepared to do a production job and require altogether too much additional training after taking their positions.

It is both interesting and educational to note the kind of training our soldiers are getting today in comparison to that received by soldiers of World War I. The men now entering battle zones for the first time have experienced almost all the situations to which they will be exposed. They have been subjected to shelling, live bullets skimming overhead just eighteen inches from the ground, bombing, hand to hand combat, sounds, sights and smells which will be experienced, exposure, long periods of intense physical exertion, etc. This kind of training is paying big dividends.

We can benefit greatly by this example. One of the most important phases of a training program for welders should be teaching the students how to handle various actual problems which they will encounter in the field, and to do this they must be subjected or exposed to these same conditions in the school. Too many students practice almost entirely under ideal conditions which include new plates, perfect fit-up, comfortable position, one or two sizes of just one type electrode, and otherwise unreal circumstances. Then when they get out and have to stand on a ladder hanging on with one hand, and must produce a satisfactory weld on poorly fit material with a strange electrode, they are in trouble.

Most courses are pretty well standardized as far as the typical joints and positions go; namely, butt, lap and fillet welds in the flat, horizontal, vertical and overhead positions. Some schools include a certain amount of lecture, movies and demonstration while others concentrate almost entirely on practical work or actual welding.

Following are several suggestions which, if not being followed, should be incorporated or greatly stressed in our present-day welding schools. The writer is primarily concerned with shipyard training schools, but the ideas presented should be of interest to others connected with the education of welding operators.

Early in the course the students should be acquainted with the various types of machines which they will use in the yard or shop. Some schools have only one or two types, whereas the yard may contain five or six makes. Instructions should be given on starting, stopping, current setting and polarity changing. There should be at least one of each type in the school for demonstration purposes at least. Students should use several different welders, perhaps progressing from booth to booth in the school. Machines of the same type vary enough so that it would be helpful for the student to get this experience. Dummy control boxes can be used in the lectures to put across this information.

The different types of electrodes should be presented, described and discussed so that students will know the operating characteristics of each, where and when they should be used and the exact technique for handling them. Some schools give no instructions in the use of E 6020 or E 6030 "hot rods," and because they differ considerably from the general purpose electrodes, new welders have difficulty.

Students should have practice on all sizes to be used outside, usually those from $^1/_8$ to $^1/_4$ in., inclusive. They should not be held strictly to $^5/_{32}$-in. electrode as is sometimes the case. Approximate current settings for each size of each type should be strongly implanted in the minds of the students. Attention should be given especially to the use of $^3/_{16}$-in. electrode for vertical and overhead welding. There is an excessive amount of $^5/_{32}$-in. electrode being used simply because students are not properly instructed in the use of the $^3/_{16}$-in. size.

Stress should be placed on the operator learning to weld in all four directions; to the right, to the left, away and toward himself. This is important when it becomes necessary to counteract arc blow or to follow a sequence which calls for welding in a direction not normal to the welder.

Complete instructions should be given on tack welding in all positions, emphasizing the required length, size and penetration of such welds. Many students go through school, learn to weld, and pass their tests but still can't do a first-class job of tack welding. This may seem insignificant but poor tacks can cause a great deal of trouble.

Students should be shown and taught how to close up wide gaps. In some cases this means building out on one or both plate edges until the opening is within specifications and then getting a sound weld without going through.

Welding in awkward, unnatural positions is very important training. The student should be required to weld while kneeling, squatting, hanging onto something with one hand, lying on his back, etc. This is especially helpful with women who naturally react differently than men to assuming such unnatural positions. This is a situation which will confront welders in the yard, so they should be trained accordingly.

One of the most important lessons to include in a welding course is the production of correct weld sizes and

* This article represents the views of the author and does not necessarily represent the views of the Bureau of Ships or the Navy Department.

† Welding Engineer, Bureau of Ships, Navy Department, Washington, D. C.

properly proportioned welds. There is a tremendous amount of time and weld metal wasted because of oversized and undersized welds—chiefly the former. A very large percentage of operators make fillets welds with the horizontal leg twice the size of the vertical leg. This large horizontal leg does no good whatsoever. Others make welds too small so that a second pass is required taking twice the time necessary. If students are properly instructed along this line, the over-all savings are great. If possible, students should acquire low-priced fillet-weld gages.

Instructions should be given on welding sequences including the reasons for their use. The technique of backstepping, skip welding and block welding should be taught. These are important in controlling shrinkage with its resultant locked-up stresses and distortion.

The conservation of material should be emphasized during the course. This is the best time to start the operators on consuming electrodes to 2-in. stubs. Scrap plates in the school should be fully utilized. Machines should be shut off during lunch periods and at the end of sessions. Lay the ground work for the good habits which should be developed in the yard. Teach students to care for electrode holders and to report immediately when holders, cables or machines need the attention of a maintenance man.

Students who are going into a specialized application of welding such as pipe or sheet metal should be held in the school after the regular course is completed, and spend additional time on this kind of material. In fact, experienced operators who are changing from welding of a general nature to pipe or sheet metal might well be called into the school for specialized instruction and practice.

Welds should be broken in the school in the presence of the students. In this way defects can be revealed to them and suggestions made as to how to correct them. The importance of making good sound welds should be emphasized all through the course. A sense of responsibility should be instilled in the welders, so they will better appreciate the fact that human lives may depend on the quality of the welding they are called on to do.

The student should become acquainted with correct welding terms and symbols. These can be given on mimeographed sheets and demonstrated in chalk talks. Reading references should be given for the benefit of those desiring additional information and knowledge.

It is surprising to note that some schools are turning out welders in 120 to 150 hours while others are taking 250 to 300 hours to given essentially the same course. The average welding course, even one which includes the suggestions just given, should not require over 150 hours. A fairly suggestive breakdown would be 32 hours on flat, 48 on vertical, 32 on overhead, and 24 hours on special problems such as large electrodes, openings and control of undercut, leaving 14 hours for lecture, demonstrations and movies.

Students coming out of schools are not expected to be all-around expert operators, but with proper training they should be able to step in and do a production job worthy of the wages paid. Time, money and production are lost for every bit of training the welder needs in the yard or shop, which he should have received in the welding school.

Statement of the Ownership, Management, Circulation, etc.

REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933

OF THE WELDING JOURNAL, published monthly at Easton, Pa., for October 1, 1943.

State of New York } ss.
County of New York }

Before me, a Notary Public in and for the State and County aforesaid, personally appeared William Spraragen, who, having been duly sworn according to law, deposes and says that he is the Editor of THE WELDING JOURNAL and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Name of — Post Office Address

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Editor, William Spraragen, 33 W. 39th St., New York, N. Y.
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WILLIAM SPRARAGEN, Editor.

Sworn to and subscribed before me this 11th day of October, 1943. (Seal) MARY T. HICKEY
Notary Public, New York County Clerk's No. 154.
New York County Register's No. 4 H 310.
(My commission expires March 30, 1944.)

THE AMERICAN WELDING SOCIETY

ACTIVITIES — RELATED EVENTS

ANNUAL MEETING OF AMERICAN WELDING SOCIETY OPENS WITH PRESENTATION OF MEDALS AND AWARDS

Presentation of the 1942 Samuel Wylie Miller Memorial Award, the Lincoln Gold Medal Award for 1942–43 and the annual award of prizes by the Resistance Welder Manufacturers' Association, and the presentation of the Adams Lecture featured the opening session of the 24th Annual Meeting of the AMERICAN WELDING SOCIETY the morning of Oct. 18th at Hotel Morrison, Chicago, Ill.

The award of the Miller Medal was made to Dr. David S. Jacobus, retired consulting engineer of the Babcock & Wilcox Co., Barberton, O., for the most conspicuous contribution to research, standardization and advancement of welded construction.

Award of the Lincoln Gold Medal was made to Gilbert E. Doan, professor of metallurgy and head of the department of metallurgy, Robert B. Stout, instructor in metallurgy, and John H. Frye, Jr., associate professor of metallurgical engineering, all of Lehigh University, Bethlehem, Pa., co-authors of the paper entitled, "Preserving Ductility in Weldments," published in the July 1943 issue of THE WELDING JOURNAL, and judged the greatest contribution to the advancement and use of welding for the year. Each man received a medal.

Recipients of the annual award of the prizes by the Resistance Welder Manufacturers' Association were:

University Prize, $100: Awarded to W. F. Hess, assistant professor in metallurgical engineering and head of welding laboratory, and D. C. Herrschaft, both of Rensselaer Polytechnic Institute, Troy, New York, for their paper entitled, "The Spot Welding of 0.040 In. S.A.E. X-4130 Steel," published in THE WELDING JOURNAL, October 1942.

Industrial Prize, $100: Awarded to Richard Della-Vedowa, production research department, and Mabel Macferran Rockwell, production research engineer in charge of research and development, both of Lockheed Aircraft Corporation, Burbank, Calif., for their paper entitled, "The effect of Welding Spacing on the Strength of Spot-Welded Joints," published in THE WELDING JOURNAL, October 1942.

Honorable Mention: Awarded to F. B. Hensel, metallurgical consultant, E. I. Larsen, research engineer, and E. F. Holt, senior research engineer, all of P. R. Mallory and Company, Indianapolis, Ind., for co-authorship of a paper entitled, "Refrigerant-Cooled Spot Welding Electrodes," published in THE WELDING JOURNAL, December 1942.

The first Adams Lecture was presented very ably by Dr. C. A. Adams in whose name the lectureship was founded. Dr. Adams described some unusual experiments relating to transient heat flow problems in Resistance Welding.

From the point of view of attendance at the technical sessions, the Annual Meeting was the greatest in the history of the SOCIETY. Practically all sessions except those in the very largest meeting room displayed the sign "Standing Room Only." The registered attendance was over 1500, but the total number attending the sessions included several hundred additional engineers who carried registration badges of other societies. Technical papers have been or will be published as soon as possible. Other interesting features of the Annual Meeting will be described in later issues of THE WELDING JOURNAL.

PRESENTATION OF SAMUEL WYLIE MILLER MEMORIAL AWARD TO DR. D. S. JACOBUS, OCTOBER 18, 1943

By H. C. Boardman

Each year the AMERICAN WELDING SOCIETY donates a medal to commemorate the unique contributions of Samuel Wylie Miller to the science and art of welding, his effective work in putting welding in its proper place as a recognized method of joining metals, and especially his help to the SOCIETY in its early struggling years. The recipient is chosen by the Board of Awards as most deserving for conspicuous contributions to the advance of the science and art of welding or cutting metals.

The medalist this year is rich in experience, deeds, wisdom and character. He is a scholar, educator and author of note, great engineer and true gentleman. His achievements have not been of the sensational type, but have resulted from steady, patient effort—sometimes in the face of much discouragement and opposition.

The recital of only a few of his many offices and honors will suffice to indicate the range and diversity of his activities. He was a student and professor at Stevens Institute of Technology, where he received his doctorate of engineering. For a long time he was advisory engineer and head of engineering for the Babcock & Wilcox Co. He has been president of at least three national technical societies—the American Society of Refrigerating Engineers, the American Society of Mechanical Engineers, and the AMERICAN WELDING SOCIETY. The Rules for marine boilers and piping bear the imprint of his mind. The International Acetylene Association conferred upon him the Morehead Medal for leadership in formulating codes and procedures. He was a pioneer experimenter in the use of the oxyacetylene torch. Of both A.W.S. Welding Handbook Committees he was chairman.

To the SOCIETY membership generally he endeared himself as president by taking the time and making the effort to visit nearly all Sections and enter wholeheartedly into their individual problems.

In the engineering world at large, wherein he is recognized as a giant in the field of steam engineering, there stands out above all of his other great services his service as a member of the A.S.M.E. Boiler Code Committee which, beginning when all pressure vessels were riveted, has been continuous through the bare electrode era and into the coated electrode era until now when practically all pressure vessels are welded. He became chairman in 1936. In a very real sense the A.S.M.E. Boiler Code, which is the pressure vessel bible of the world, is a monument to him because so much of him is in it. Probably no other single document has so advanced the use of welding.

Two years ago he resigned the chairmanship of the committee and accepted the honorary chairmanship, but is today one of the most active and productive members. His new associates soon discover that back of his invariably quiet speech and gentle manner are an inflexible will and devotion to principle, coupled with unusual kindliness, insight and fairness; sound judgment and surpassing skill in getting men of diverse opinions and interests to work effectively together. No one who has served with him on this committee as I have been privileged to do, can forget his unfailing insistence upon maintaining against all odds the safety features of the Code, and yet withal his readiness and eagerness to incorporate in the Code new features of proved worth.

He has been admiringly and affectionately characterized as a "lovable villain" by some of those who have tried to take him on a "buggy ride" to their own objectives but at the end of the journey have found themselves at his goal.

If Samuel Wylie Miller were here today he would look upon this ceremony with complete approval.

In the name of the AMERICAN WELDING SOCIETY and its Board of Awards it is my privilege and honor to confer upon you, Dr. David Schenck Jacobus, in recognition of your great contributions to the science and art of welding and cutting metals, the Samuel Wylie Miller Memorial Medal and the Certificate of Award.

ACCEPTANCE OF THE MILLER AWARD

By Dr. D. S. Jacobus

I thank Mr. Boardman for his kind remarks.

Mr. Miller was in the class of 1887 at the Stevens Institute of Technology where I was one of his instructors and I had an opportunity to know him. He had a distinguished and useful career. He gave the Boiler Code Committee invaluable help in the early days when help was sorely needed, and the Committee grew to depend on him for advice and guidance.

He was a member of the Pressure Vessel Committee of the American Bureau of Welding that conducted tests at the U. S. Bureau of Standards which were reported in 1923.

When the State of California was preparing its Air Pressure Tank Safety orders, Mr. Miller was delegated by the Boiler Code Committee to confer with those undertaking the work. He visited the Pacific Coast and assisted in establishing the working stresses that were agreed on for what was then called Autogenous Welding. These were embodied in the Safety Orders issued by California in 1928, and shortly thereafter these same working stresses were included in the first edition of the A.S.M.E. Unfired Pressure Vessel Code.

There were a number of failures and the use of autogenous welded vessels was opposed by the inspectors in charge of the enforcement of the Code.

He was one of the first to appreciate the superiority of ductility in welds. He proposed using the term "fusion welding" in place of "autogenous welding" as the more descriptive term and one that would differentiate the newer and better practice from the old.

It was indeed unfortunate that he should not live to witness the fruition of his efforts. His death in 1929 was at a time which marked the turning point in the general use of fusion welding in industry.

His was a life well spent in contributing vital elements which eventually led to outstanding success in the development of his chosen field. It is the highest of honors to receive the Medal which bears his name. I will cherish it in his memory and as a token of good will of those who awarded it to me.

DR. DAVID S. JACOBUS

Dr. Jacobus was born in Ridgefield, N. J., January 20, 1862. He married Miss Laura Dinkel of Jersey City on April 5, 1899, and has two children. Dr. Jacobus graduated from Stevens Institute of Technology in 1884. He received a degree of Doctor of Engineering in the same university in 1906. He taught experimental mechanics and engineering of physics at Stevens Institute from 1884 to 1906, and in the latter year he joined the Babcock & Wilcox Company as advisory engineer and was also head of the engineering department.

He has written many papers and is considered one of the world's authorities on steam engineering. He is a member of

David S. Jacobus

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many societies, including the American Society of Mechanical Engineers, Society of Naval Architects and Marine Engineers, American Institute of Mining Engineers, American Mathematical Society, Society for the Promotion of Engineering Education, American Institute of Electrical Engineers, American Society for Refrigerating Engineers, Franklin Institute, The Holland Society of New York, American Association for the Advancement of Science, as well as the AMERICAN WELDING SOCIETY.

His presidency of the A.W.S. in 1934–35 was his third service in this capacity. He served as president of the American Society of Refrigerating Engineers from 1906–1907, and president of the American Society of Mechanical Engineers from 1916–17.

As far back as 1897, Dr. Jacobus experimented with the use of the oxyacetylene torch and an account of some of these experiments is published in the *Journal of the Franklin Institute*, March 12, 1897. These experiments also included the cutting of thin steel.

Members of the AMERICAN WELDING SOCIETY know Dr. Jacobus best in connection with his work as chairman of the Executive Committee of the Boiler Code Committee. Dr. Jacobus has followed the developments of welding with keen interest. From the outset he saw the possibilities of welding and in his capacity with the Boiler Code Committee gradually brought about the more liberalization of the rules dealing with the welding of pressure vessels, keeping in mind, however, suitable safety provision so that at the present time there is no limitation on the use of welding for any thickness of size of pressure vessels providing the welding is properly done and meets required tests. Dr. Jacobus was instrumental in bringing about close cooperation and harmony with the AMERICAN WELDING SOCIETY and the American Society of Mechanical Engineers.

His work for many years as Advisory Engineer of The Babcock & Wilcox Company and as a member and Chairman of the A.S.M.E. Boiler Code Committee particularly fitted him for judging the safety of boilers and pressure vessels. The difficulties in riveting thicker and thicker plates to meet the demands of increasing working pressures and troubles through caustic embrittlement, made him an enthusiast in developing a safe welding process.

In 1929 The Babcock & Wilcox Company made tests at its plant at Barberton, Ohio, under the direction of Professor H. F. Moore of the University of Illinois, on fusion-welded vessels under intermittent pressures, in which he cooperated. These tests demonstrated the dependability of properly made fusion welds and established the working stresses which could be safely used. After these tests the U. S. Navy issued specifications for fusion-welded drums, including the requirement that the main seams be X-rayed, and the Boiler Code Committee published proposed Specifications for Fusion-Welded Drums or Shells of Power Boilers.

He is a member of the A.W.S. Committee on Welding in Marine Construction and Chairman of its Subcommittee on Boilers, Pressure Vessels and Piping. He took an active part in preparing the welding section of the Rules issued by the U. S. Steamboat Inspection Service in 1935.

When president of the A.W.S. he visited nearly all of the Sections of the Society. All favored his proposal that the Society prepare a Welding Handbook. He was Chairman of the Handbook Committees which prepared the first and second editions.

He is the representative of the American Society of Mechanical Engineers on the Panel of Consultants to advise the Merchant Marine Council.

He was awarded the Morehead Medal by International Acetylene Association for the year 1935 for leadership in formulating codes and procedures, and received the National Association of Manu-

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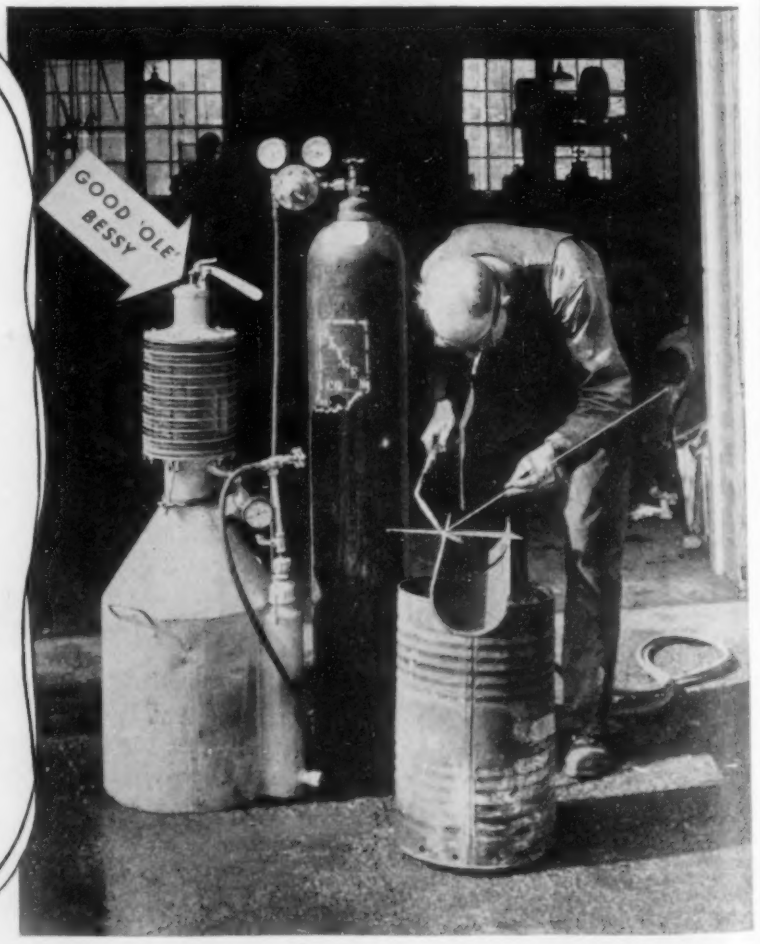

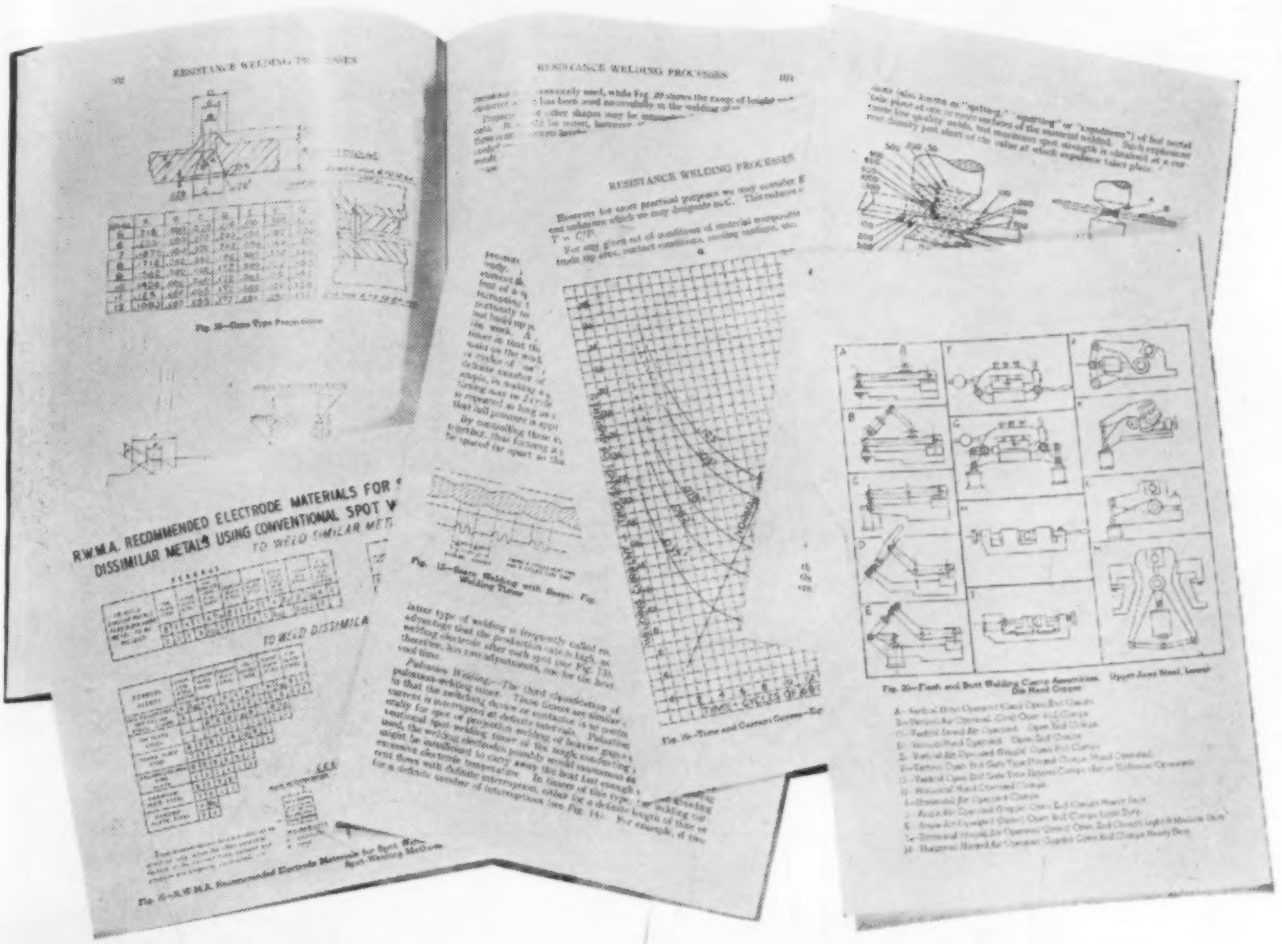

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facturers Award as a "Modern Pioneer" of American Industry.

It would undoubtedly have given Sam Miller, in whose name the Miller Medal was founded, a particular degree of satisfaction in the award of the Miller Medal to Dr. Jacobus, who was one of his co-workers on the A.S.M.E. Boiler Code Committee.

BIOGRAPHICAL INFORMATION

Recipients of Resistance Welder Manufacturers' Association Prizes

W. F. HESS graduated from Rensselaer Polytechnic Institute in 1925 with the degree of Electrica Engineer and in 1928 received the degree of Doctor of Engineering. From 1928 to 1930 he was an instructor in electrical engineering and physics at Rensselaer. In 1929 he began teaching a course in welding to United States Navy Annapolis graduates sent to the Institute by the Bureau of Yards and Docks for special training. He served as assistant professor of electrical engineering and physics from 1930 to 1937 and in 1938 became assistant professor in metallurgical engineering and head of welding laboratory, which is his present position. He is chairman of the Committee on Awards, AMERICAN WELDING SOCIETY and is a member of American Institute Electrical Engineers and the Society for the Promotion of Engineering Education.

W. F. Hess

RICHARD DELLA-VEDOWA, a graduate in 1940 of the University of California with a B.S. degree in Mechanical Engineering, enrolled as an engineering trainee at the Lockheed Aircraft Corp. at Burbank, Calif. After completing his training, he was assigned to the production research department of that company investigating various phases of resistance welding. He is a technical member of the Institute of the Aeronautical Sciences.

R. Della-Vedowa

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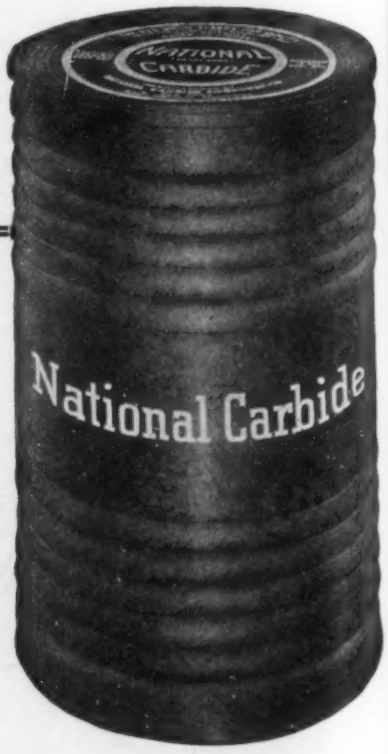

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MABEL ROCKWELL was born in Philadelphia in 1902. She attended the Massachusetts Institute of Technology where she received a B.S. degree in Electrical Engineering in 1925 and E.E.E. in 1926 at Stanford University. From 1926 to 1931 she was a member of the Southern California Edison Co., first as testman and laboratory technician and later technical assistant to the operating engineer, making short-circuit and stability studies on the 220-kv. Big Creek transmission system. From 1931 to 1936 she served as an assistant electrical engineer, designing high-voltage system for transmitting power from Boulder Dam to Aqueduct pumping system for the Metropolitan Water District of Southern California (Colorado River Aqueduct). In 1938 she joined the Lockheed Aircraft Corp. as plant electrical engineer and then subsequently as production research engineer in charge of research and development on such processes as spot welding, flash welding, sheet metal forming, etc.

F. B. HENSEL received his schooling in Saxony, England, and Germany. At present he holds the posts of section engineer, Westinghouse Electric and Manufacturing Co., and metallurgical consultant for P. R. Mallory & Co., Inc. He has obtained over 100 U. S., British and Canadian patents on alloys and processes. Is a member of numerous technical societies and author of 20 or more scientific papers.

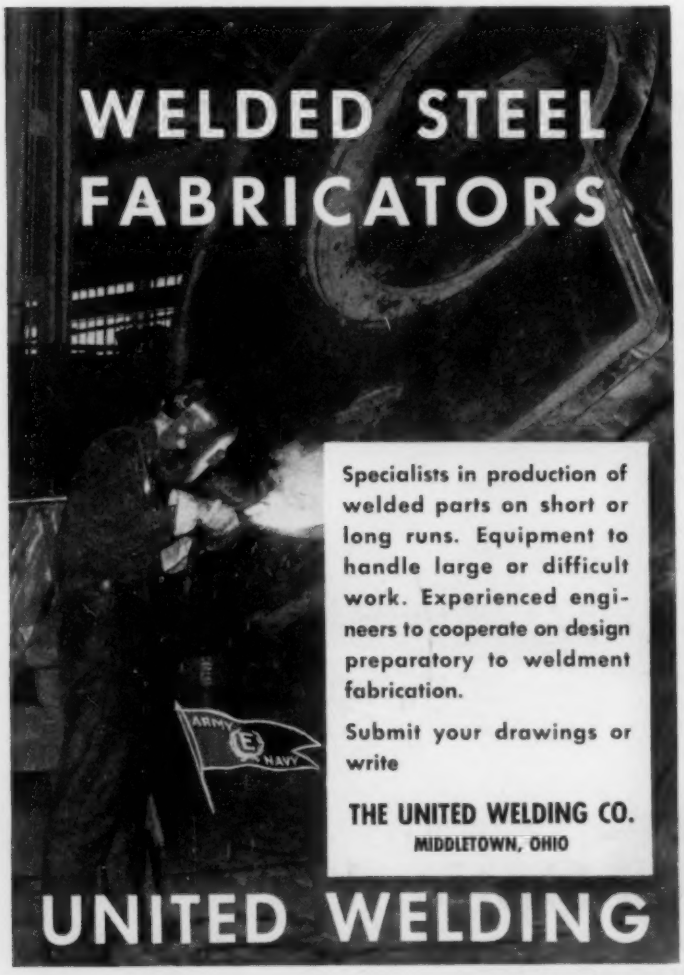
E. I. LARSEN, a graduate of Carnegie Institute of Technology, has served as research engineer at Westinghouse Electric and Manufacturing Co., metallurgical engineer for Driver-Harris, Harrison, N. J.; with P. R. Mallory and Co., Inc., since 1935. Inventor and co-inventor of many non-ferrous alloys and processes. Mr. Larsen has also written numerous scientific papers.

E. F. HOLT, a Drexel Institute graduate, has been with P. R. Mallory & Co., Inc., for seven years where he now is senior research engineer. Is author and co-author of many papers on resistance welding research. Holds several important patents at present, with others pending.

* * *

Recipients of 1942–43 Lincoln Gold Medal Award

GILBERT E. DOAN, professor of metallurgy and head of the Department of Metallurgy at Lehigh University, was born in Lansdale, Pa. He graduated at Lehigh in 1919 and became metallographist under Dr. D. J. McAdam at the U. S. Naval Engineering Experiment Station at Annapolis, Md. In 1920 he became Director of Research of the Una Welding Co. in Cleveland, and in 1922 was sent by that firm on a special mission to Europe. In 1927 he received the Ph.D. degree from the University of Berlin, Germany, and joined the faculty at Lehigh University. At the U. S. Naval Research Laboratory, together with Robert F. Mehl and Charles S. Barrett, he developed the use of gamma rays from radium for the inspection of welds and castings.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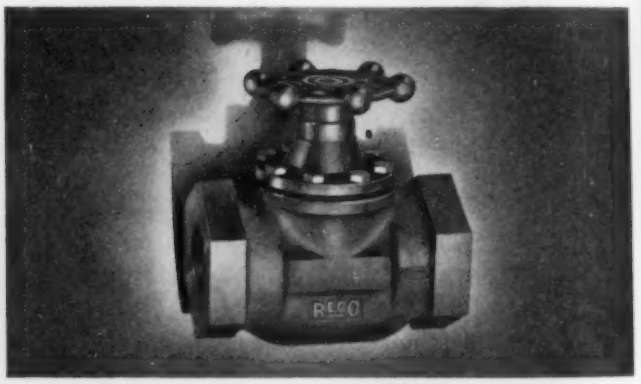

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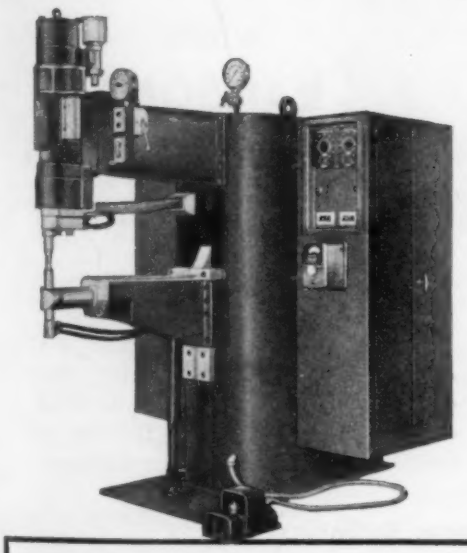

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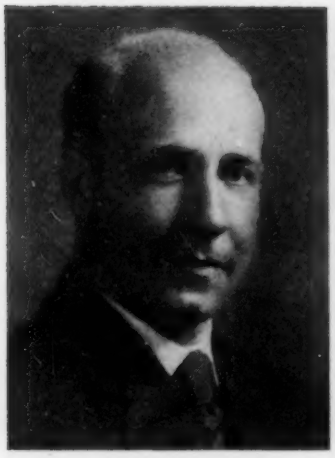


G. E. Doan

R. D. Stout

J. H. Frye, Jr.

The Engineering Foundation has sponsored welding research at Lehigh under his direction since 1930. In 1942 the financing of these studies was taken over by the Office for Scientific Research and Development in Washington. He is the author of a textbook, *The Principles of Physical Metallurgy*, the second edition of which appeared in 1942.

ROBERT D. STOUT was born in Reading, Pa., and educated in the public schools there. He received a B.S. from Penn State in 1935 and an M.S. from Lehigh University in 1941. From 1935 to 1939 he was connected with the research laboratories of the Carpenter Steel Co. Since 1939 he has been instructor in metallurgy at Lehigh University. His doctorate work is on the subject of weldability.

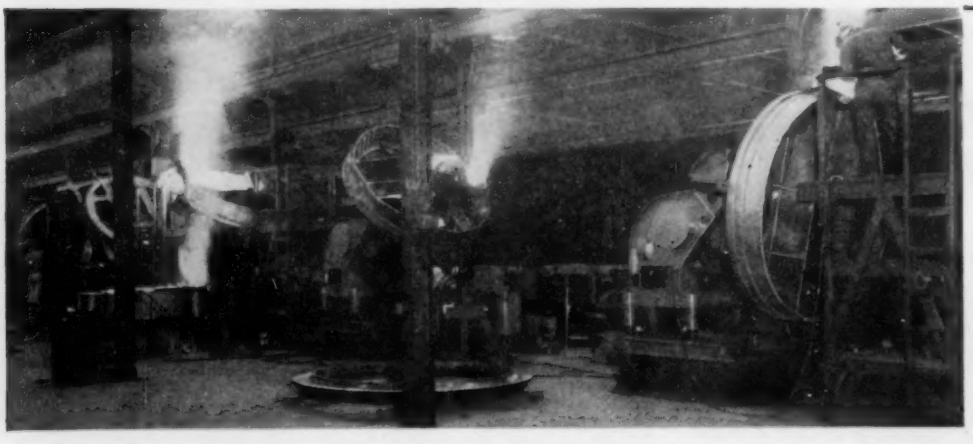
JOHN H. FRYE, JR., was born in Birmingham, Ala. He received an A.B. from Howard College in 1930 and attended Lehigh University, after a year of travel and work, where he received an M.S. in metallurgical engineering in 1934. After graduation he worked for the National Cast Iron Pipe Co. and later the American Cast Iron Pipe Co. both of Birmingham. In 1935 he returned to Lehigh as an instructor in metallurgical engineering. Later, leave of absence was secured to work under Dr. William Hume-Rothery, F.R.S., at Oxford University where Dr. Frye secured his Ph.D. in the field of physical metallurgy. Dr. Frye is now associated with Lehigh University as an associate professor of metallurgical engineering. He has had papers published by the American Society of Metals, the Royal Society and the American Institute of Mining and Metallurgical Engineers.

BY-LAW AMENDMENTS

By-law amendments and additions to By-laws as published in the July WELDING JOURNAL and submitted for letter ballot vote on August 9th now stand approved and will be incorporated in the By-laws appearing in the 1944 Year Book.

KINZEL, 1944 ADAMS LECTURER

At a meeting of the Board of Directors held recently Dr. A. B. Kinzel was unanimously selected as the 1944 Adams Lecturer.



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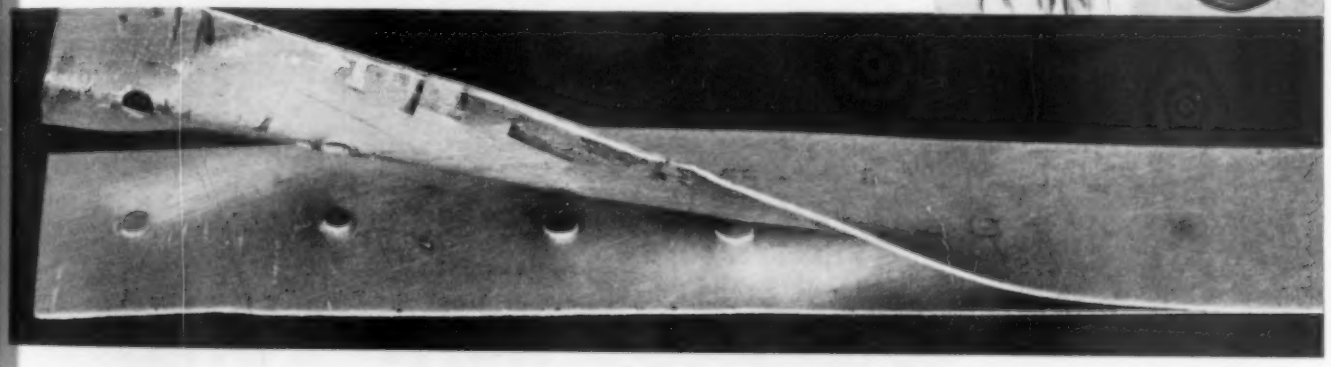
In another plant, considerable difficulty was experienced in producing acceptable welds in sufficient volume. After adopting the Diversey Process, the faulty welds disappeared and immediately the work was accepted. Production is now running smoothly with a greatly increased volume of work each day. Over 400 welds are now being obtained before tip cleaning is necessary.



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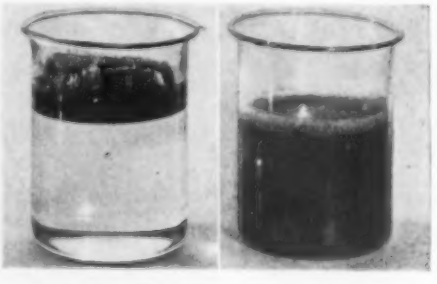

Make this simple test. Add some light oil to raw acid in a beaker. Note how the oil floats on top . . . proof that the acid has little effect on the oil. Now add the same oil to a solution of D-C No. 1. Note how the oil is distributed in the solution . . . proof that D-C No. 1 solutions can wet and penetrate the surface and make contact with the metal. This assures uniform removal of the oxide film and consistent welding results.

BOUND VOLUME JOURNAL

The AMERICAN WELDING SOCIETY has made arrangements for members who wish to have their Journals for 1943 bound in attractive, imitation black leather covers, to do so by sending copies of the twelve issues to Russell-Rutter Company, Thirty-Third Street and Eighth Avenue, New York, N. Y., Att. Mr. Russell Lauben, Jr. A special reduced rate has been arranged at $2.50 per volume providing the issues of the JOURNAL are sent to the binder on or before Jan. 15, 1944. Journals received after this date cannot be bound at this reduced rate. The bill for the binding and return postage will be sent direct from the Society's office.

SUSTAINING MEMBERS

Willys-Overland Motors, Inc., Toledo, Ohio, manufacture the following: Confidential and/or secret equipment for the Navy; 155-mm. shells; "Jeeps," originated at W. O.; Naval ordnance parts; Landing gears for "Grumman;" "Wildcat" airplanes; Wings for Vought Sikorsky "Corsair;" Jeep trailers; Aluminum forgings; Steel; Ordnance parts for the Army. Our production is 100% war material.

Henry Pratt Company, 2222 So. Halsted St., Chicago, Ill., are engineers, steel plate fabricators and machinists.

SUSTAINING COMPANIES

The Canadian Bridge Co. Ltd., of Walkerville, Ontario, Canada, has a record of 40 years in the structural steel business. Its products are to be found around the world in countries such as India, South America, Norway, New Zealand, Jamaica. The company has been connected with some of the largest engineering projects in Canada. During the last two years the resources of the company have been given over to numerous war products including marine engines and welded ships; to date this year the company has launched 23, completed and delivered 20.

The Nordberg Manufacturing Company, Milwaukee, Wis., builds heavy machinery such as Diesel engines for stationary and marine service in sizes up to 6000 hp. Steam engines are built in uniflow, poppet valve and Corliss designs for generator drive and for direct connection to other equipment. Nordberg has specialized in the building of mine hoists for hoisting heavy loads from great depths at high speeds. Compressors are built for air and various gases. Nordberg also builds the Symons Cone Crusher for rocks and ores, vibrating screens and power-driven tools for track maintenance.

The Weldit Acetylene Company, Detroit, Mich., was organized in 1918 as a distributor of acetylene welding and cutting equipment. Later it engaged in the manufacture of the majority of its own apparatus. It was the pioneer and the originator of the Automatic Gasaver, later incorporating the gas-saving feature in the welding torch. In later years it enlarged its activities to include arc welding, spot welding and kindred lines.

BOARD OF DIRECTORS MEETING, SEPTEMBER 16, 1943

Present were the following: K. L. Hansen, *President*, Presiding; (*Directors*) C. A. Adams, D. Arnott, A. G. Bissell, R. W. Clark, E. V. David, J. H. Deppeler, E. R. Fish, O. B. J. Fraser, H. O. Hill, J. H. Humberstone, F. L. Plummer, A. C. Weigel; (*Members Executive Committee*) W. E. Crawford, R. S. Donald, D. S. Jacobus, J. F. Lincoln, H. M. Priest, H. S. Smith; W. Spraragen, *Editor*, The WELDING JOURNAL; M. M. Kelly, *Secretary*.

L. S. Moisseiff

The President called attention to the death of Mr. Moisseiff, Chairman of the Society's Permanent Fund Committee, Chairman of the Structural Steel Committee of the Welding Research Council and formerly Treasurer and Vice-President of the Society. It was the consensus of the meeting that in the death of Mr. Moisseiff the Society lost a staunch friend and wise counselor.

It was voted that a committee of two be appointed to draw up sympathy

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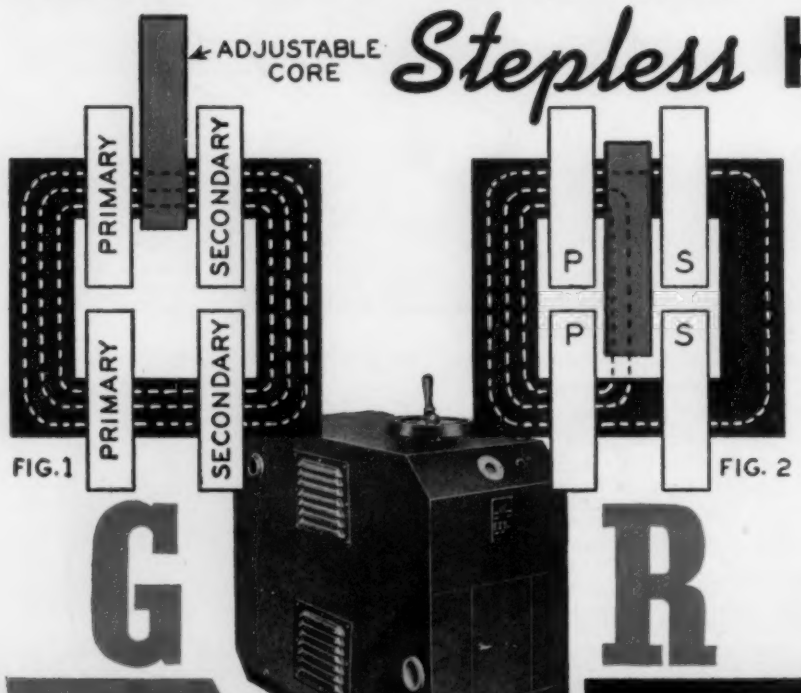

CONTROL is infinitely variable from high to low, permitting precise adjustment to fit every job. G-R's exclusive transformer design produces an increase in reactance with a decrease in amperage, giving great arc stability with small diameter rods and uniform welds at all heats. The diagrams show why. (Fig 1, maximum output position with minimum diversion of flux; Fig. 2, minimum output, for low heat welding, with maximum flux diversion.)

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RACO H-D #11. Electrodes have been thoroughly tested in all positions on A.C. welding jobs for mild steel. They assure a superior X-Ray clean weld, free from gas pockets and slag inclusions. ***Equivalent results are obtained with direct current reverse polarity.***

RACO H-D #11. Electrodes comply with the following specifications:—A.W.S.—A.S.T.M. Filler Metal Specifications A233-42T Classification E6011; Navy Bureau of Ships Specification 46E3, Grade III, Classes 1,2,3; American Bureau of Shipping Specifications HIG and BIG: A.S.M.E. Boiler Code, Paragraph U68.

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resolutions. Messrs. F. H. Frankland and Jonathan Jones, associates of Mr. Moisseiff on the Structural Steel Committee, were designated as members of this special committee.

Change in Committee Personnel

Appointment of R. B. Reid of the General Electric Company on the A.W.S. Publicity Committee to replace J. S. Smith, of the same company, was confirmed.

1944 Adams Lecturer

In accordance with rules adopted for the guidance of the Awards Committee and the Board of Directors in the selection of Lecturers for the Adams Lecture, a written ballot was taken on the recommendations of the 1943–44 Awards Committee for the 1944 Lecturer. The result of the ballot was unanimous approval of Dr. A. B. Kinzel as Lecturer.

Finances

The Finance Committee Chairman drew attention to an improvement of $10,745 over the excess of income over expense shown at this time a year ago. All items of income were greater than anticipated in the budget and the majority of expense items which showed an increase over the budget were the result of the substantial gain in membership and JOURNAL advertising.

It was voted to approve the recommendation of the Finance Committee for the transfer of $12,000 from the Society's regular fund to its Permanent Fund account.

It was voted to approve recommendation of the Finance Committee that the present ruling, governing refunds to new Sections on dues of members enrolled during the organization period, be revised to read as follows:

> "At the time of organization return shall be made to a newly organized Section on the dues of members enrolled during the six prior months to the date of organization of the Section."

Proposed Revisions to A.W.S. By-Laws

Revisions were approved as quoted below:

Article VI

MANAGEMENT

Section 1. The Board of Directors shall have the power:

(*a*) To manage the affairs of the Society, except as otherwise provided by law, or by these By-Laws.

(*b*) To purchase or otherwise acquire for the Society any property rights and privileges which the Society is authorized to acquire, at such prices and on such terms and conditions and for such consideration as they think fit.

(*c*) To appoint Executive Officers and fix their salaries.

(*d*) To determine who shall be authorized to sign, on behalf of the Society, notes, receipts, acceptances, endorsements, checks, releases, any and all contracts and other documents, and shall make such authorization; at least one signer shall be bonded.

(*e*) To perform such other acts as may be necessary to carry out the purpose of the Society.

Section 2. In each case of vacancy occurring in the Board of Directors through death, resignation, disqualification or other cause, the remaining Directors, by letter ballot, may elect or appoint a successor to hold office for the unexpired portion of the term of the retiring Director; and in the event that a quorum of the Board of Directors does not exist, the affirmative vote of a majority of the remaining Directors shall become effective. However, if the retiring Director is a District Vice-President, then the vacancy shall be filled as provided in Article V, Section 7.

Section 3. The President shall have general supervision of the affairs of the Society, under the direction of the Board of Directors. He shall preside at the meetings of the Society, and of the Board of Directors, at which he may be present, and shall be ex-officio a member of all committees. He shall submit a report of the operations of the Society for the fiscal year to the Board of Directors at their last regular meeting preceding the Annual Meeting, and to the members at the Annual Meeting in October.

Section 4. The First and Second Vice-Presidents in order of seniority, in the absence or disability of the President, shall preside at meetings of the Society and the Board of Directors, and discharge his duties.

Section 5. The District Vice-President shall be the official representative of the Society in his District. He shall be responsible for the general promotion of the Society in his District and shall act as contact man between Headquarters and his District. He shall be a member of the Section Advisory Committee and shall perform such other duties as specified in the By-Laws.

Section 6. (*a*) A Secretary shall be appointed by the Board of Directors for a term of one year and shall be, under the direction of the President and Board of Directors, the Chief Executive Officer of the Society.

(*b*) The Secretary will be expected to attend all meetings of the Society and of the Board of Directors; prepare the business therefor, and duly record the proceedings thereof.

(*c*) The Secretary shall see that all moneys due the Society are carefully collected, and without loss transferred to the custody of the Treasurer.

(*d*) The Secretary shall carefully scrutinize all expenditures and exert every effort to secure economy in the administration of the Society and shall personally certify the accuracy of all bills or vouchers on which money is to be paid.

(*e*) The Secretary shall have charge of the books of account of the Society, and shall furnish monthly to the Treasurer a statement of receipts and expenditures under their several headings, and also a statement of monthly balances, and shall furnish from time to time such other statements as may be required.

(*f*) The Secretary shall conduct the official correspondence of the Society and keep full records thereof.

(*g*) The Secretary shall have charge of

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Yet, almost overnight, American shipbuilders—"old dogs" at their business—*learned* the entirely "new trick" of constructing steel cargo vessels and war vessels by welding. If they hadn't, the "bridge of ships" that made the conquest of North Africa and the invasion of Europe possible would still be just a pipe dream.

Contributing much to the shipbuilding industry's phenomenal production records is the "researched line" of **McKay Welding Electrodes,** a preponderance of which now goes into all-welded ship construction.

In addition to these **McKay Electrodes** of Stainless, Alloy, or Mild Steel for every welding purpose, **McKay Chain**—its production stepped-up more than 400%—plays a vital role in maritime uses; and **McKay Tire Chains** help maintain the efficiency of both civil and military transportation.

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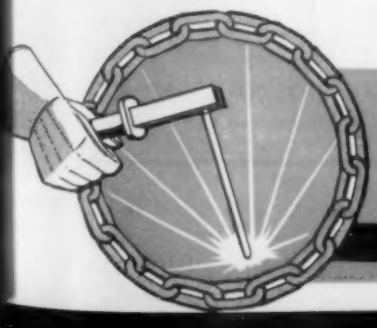

THE McKAY COMPANY
PITTSBURGH, PA.

WELDING ELECTRODES . . . COMMERCIAL CHAINS . . . TIRE CHAINS

the Society's rooms and all property of the Society.

(*h*) The Secretary shall engage such employees as may be authorized and shall be responsible for the work of all employees of the Society.

(*i*) The Secretary shall perform all other duties which may, from time to time, be assigned by the Board of Directors.

(*j*) The Secretary shall devote entire time employed to the affairs of the Society, unless otherwise authorized by the Board of Directors.

(*k*) The Secretary shall give the Society a bond in a sum, and with one or more securities as required by, and satisfactory to, the Board of Directors for the faithful performance of the duties of this office, and the restoration to the Society in the case of the death, resignation or removal from office of the Secretary, of all books, papers, vouchers, money or other property of whatever kind in the possession of the Secretary, belonging to the Society. The cost of the bond shall be borne by the Society.

Section 7. (*a*) The Treasurer shall receive all moneys and deposit the same, to the credit of the Society, in such depositaries as may be designated by the Board of Directors.

(*b*) The Treasurer shall disburse the funds of the Society as may be ordered by the Board of Directors, taking the proper vouchers to such disbursements.

(*c*) The Treasurer shall furnish at regular intervals to the Board of Directors a statement of receipts and expenditures under their several headings and also a statement of monthly balances. He shall make an annual report and such other reports as may be prescribed by the Board of Directors.

(*d*) The Treasurer shall give the Society a bond in a sum and with one or more securities as required by and satisfactory to the Board of Directors for the faithful performance of the duties of his office, and the restoration to the Society in the case of his death, resignation or removal from office of all books, papers, vouchers, money or other property of whatever kind in his possession belonging to the Society. The cost of the bond shall be borne by the Society.

Section 8. The Board of Directors may appoint an Assistant Secretary who, in the absence or disability of the Secretary, shall act instead of the Secretary.

Section 9. The Board of Directors may appoint an Assistant Treasurer, who in the absence or disability of the Treasurer, shall act instead of the Treasurer.

The By-Laws Committee recalled that at the June 10th Board meeting, attention was drawn to the fact that the duties of the District Vice-Presidents are circumscribed by the Section Advisory Committee. In order to overcome this difficulty, suggestion was made that the District Vice-Presidents be made members of the Section Advisory Committee. Accordingly, the By-Laws Committee was requested to prepare a By-Law amendment for consideration at the 1943 Section Officers Conference. The proposed revision was submitted to the Board of Directors for study but action on this revision was postponed, awaiting report from the Section Officers Conference.

Technical Matters

It was voted to approve the following two revisions to the tentative specifications for Iron and Steel Arc Welding Electrodes A233-42T, as recommended by the Outline of Work Committee:

1. The following sentence is to be inserted in the present paragraph 6 (*d*):

"After depositing each pass for electrodes of the E80-, E90- and E100- classifications, the assembly shall be left on the asbestos to cool in still air to a temperature below 212° F. before immersing in boiling water. This immersion should not quench the assembly —the boiling water is in ended simply as a preheat."

2. The values of Tensile Strength, Yield Point and Elongation in 2 inches for electrodes of the E70- classification specified for the non-stress-relieved condition in Table 1 of the present specifications should be deleted.

It was voted to approve recommendation of the Outline of Work Committee that Mr. C. W. Obert be relieved of his

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FOR CARBON-MOLY
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Murex Type M, Carbon-Moly.50 and Molex electrodes are designed *especially* for welding carbon-molybdenum steel castings and plate and high pressure-high temperature piping. They can, of course, be used for welding various other high-strength steels having tensile strengths of 70,000 lbs. per square inch and more in which pick-up of elements from the parent metal provides added weld strength.

"If you want an all-position electrode for use with direct current on reverse polarity, you can't beat Murex Molex electrodes. I've found that you get little spatter with this electrode even when used at high amperages. And it has plenty of tensile strength and ductility."

"When I've got a job of butt or fillet welding high strength steels, I use Murex Type M electrodes every time to be sure of top results. I've found that I can rely on these downhand electrodes for X-ray sound deposits, for smooth, clean welds with excellent properties. And when I'm working with silicon-killed steels, I know I can count on them to give me a weld free from reaction pits."

"For working in tight, awkward places, I'll take Murex Carbon-Moly.50 electrodes. That spiral winding of asbestos yarn anchors the coating to the core wire and makes it possible for me to bend the electrodes so that I can get at *any* job. And, of course, they have the same swell advantages as the Murex Type M rod."

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A large wall chart listing *all* the important facts to help you quickly select the right Murex electrode—physical characteristics, suggested applications, advantages. And in addition, six suggestions are given to improve welding practice. Copies are obtainable from Metal & Thermit or your own Murex distributor. Get *your* free copy today.

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duties as Acting Technical Secretary and further that Mr. S. A. Greenberg be elevated to the position of Acting Technical Secretary, effective October 1, 1943, and continuing for the duration.

Further, it was voted that a vote of thanks be extended to Mr. Obert in appreciation for the valuable assistance rendered the Society in his capacity as Acting Technical Secretary.

For the information of the Board of Directors, the Chairman of the Outline of Work Committee reported that an election of officers of the Outline of Work Committee had been held and Mr. R. W. Clark and Mr. H. O. Hill were re-elected as Chairman and Vice-Chairman, respectively. Mr. Clark stated that his acceptance of the chairmanship was with the understanding that he will retain the office for only one more year.

As another matter of information, Mr. Clark reported the receipt of a communication from the Chief of the Service Branch of the Technical Division of the Office of Chief of Ordnance, in which it was suggested that the A.W.S. might prepare an inspection manual on welding for the Ordnance Department. At a later conference with the Chief of the Service Branch, it was definitely agreed (*a*) that the A.W.S. should have a committee to work on Ordnance welding problems, the first being the inspection manual, (*b*) that such committee should have Ordnance Department representation, and (*c*) that the Ordnance Department should recommend and approve the personnel of the A.W.S. committee.

Appreciation

Since it was the last meeting of the Board of Directors to come under his administration, President Hansen took occasion to express to the members of the Board his sincere appreciation for their leniency and assistance during his incapacitation and especially he thanked the First Vice-President, the Treasurer and headquarters staff for their guidance and help during the year.

A rising vote of thanks was given by the members of the Board to President Hansen in heartfelt appreciation for all he has done during his regime to advance the ideals and prestige of the Society.

T. H. WICKENDEN HEADS INCO DEVELOPMENT AND RESEARCH DIVISION, H. J. FRENCH ASSISTANT MANAGER

Appointment of T. H. Wickenden as Manager of the Development and Research Division of the International Nickel Company and H. J. French as Assistant Manager is announced by Robert C. Stanley, President of the Company.

Mr. Wickenden, who has been Assistant Manager of the Division since 1931, succeeds the late Albion James Wadhams. He is well known in engineering circles in the automotive industry, having been in charge of engineering at Studebaker Corporation's South Bend plant from 1913 to 1920.

Mr. Wickenden worked with Chrysler engineering group and specified the materials in the first Chrysler car. He joined International Nickel in 1922 when he was placed in charge of developments in the automobile field for the Development and Research Department at New York. Numerous inventions connected with the use of nickel in cast iron are credited to him and his papers and engineering data sheets on the use of nickel in steel and cast iron have been widely published in trade journals.

A native of Toledo, Ohio, he attended Denison University, Granville, Ohio, and received his engineering degree at the University of Michigan. He married the former Dee F. Shuman of Covington, Ohio, in 1916. His residence is at Short Hills, N. J.

Mr. Wickenden is a member of the following: Society of Automotive Engineers, American Society for Mechanical Engineers, American Institute of Mining and Metallurgical Engineers and American Society for Metals. He served as a member of the Iron Alloys Committee of The Engineering Foundation which has published the Alloys of Iron Research Monograph Series. His clubs include City Midday Club and Downtown Athletic of New York and the Short Hills Club, Short Hills, N. J.

Mr. French is temporarily serving in the Steel Division of the War Production Board in Washington, D. C. He has been in charge of Alloy Steel Development in International Nickel's Development and Research Division at New York since 1932, previous to which he had been a member of Nickel's Research Laboratories in Bayonne, N. J., for 3 yr.

He is President of the American Society for Metals. Besides membership in that society he is a member of the American Iron and Steel Institute, American Society for Testing Materials, Institute of Mining and Metallurgical Engineers and the Columbia University Club.

Mr. French received his degree of Metallurgical Engineer from the School of Mines, Columbia University, in 1915. At the outbreak of the first World War he entered the Signal Corps, U. S. Army, as a civilian materials inspector in the Aircraft Division, which was later separated into the Bureau of Aircraft Production. In 1919, he joined the metallurgical staff of the U. S. Bureau of Standards in Washington, as Assistant Physicist, and was successively Associate Physicist, Metallurgist, Senior Metallurgist and Assistant Chief of the Division of Metallurgy.

He received the Henry Marion Howe medal of the American Society for Steel Treating in 1931, and in 1933 was the Edward de Mille Campbell memorial lecturer for the American Society for Metals. Mr. French was honored in the Fall of 1940 for his contributions to the development and advancement of welding, having been co-author of the 1940 Lincoln Gold Medal award paper, "Weld Hardening of Carbon and Alloy Steels."

TLACH JOINS AGILE

Victor F. J. Tlach has resigned as President of Darwin & Milner, Inc., Cleveland, Ohio, after occupying that position for nearly thirty years. He is well known as a pioneer of High Carbon-High Chromium Tool Steels, having been intimately connected with their original discovery at Sheffield, England, and was prominently identified with their introduction to the U. S. A. and their subsequent development. He has joined the American Agile Corp., 5806 Hough Ave., Cleveland, Ohio, specialists in welding electrodes.

NEW RANSOME LITERATURE

A new four-page, two-color bulletin, No. 201, has just been released by the Ransome Machinery Company, Dunellen, N. J.

The bulletin presents in concise form the full Ransome line of welding positioning equipment: specifications, important features, load rating tables and dimensions are included.

Copies may be obtained by addressing the company.

McKAY PROMOTION

Announcement has just been made by the McKay Co., Pittsburgh, Pa., of the election of Thomas J. McKay, formerly president and treasurer, to chairman of the board, in which position he will continue to maintain an active and directing interest in the policies of the company. Mr. James C. McKay, formerly vice-president, was advanced to the offices of president and treasurer.

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ELECTROLOY ALLOYS were developed specifically for the resistance welding industry. ELECTROLOY ALLOYS cover the full range of physical properties necessary to the manufacturers and users of resistance welding equipment.

Our engineers will be glad to make recommendations for your special electrodes. Submit samples or specifications.

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WILSON "HONEY BEE"

This battery of Wilson "Honey Bee" stations helps North American Aviation, Los Angeles, Calif., to get *better quality welding* on light metal — and *more welding* from every constant potential welding machine.

Two Wilson "Honey Bees" are connected to every Wilson "Hornet" generator, thus doubling the number of welding operations that can be performed at once from a single generator. Each operator using a "Honey Bee" station holds a remote arc control switch, which enables him to regulate his current from zero to maximum while welding — without first extinguishing the arc. In addition, the "Honey Bee's" Remote Crater Control permits the operator to fade out the arc slowly to prevent craters, porosity, and similar weld defects.

The Wilson "Honey Bee" is made in 75 amp. and 150 amp. sizes. For full details write to Wilson Welder and Metals Co., 60 East 42nd St., New York 17, N. Y.

Long favored by operators for its fine all-around performance, the Wilson "Hornet" gives excellent service as a power source for "Honey Bee" stations. A convenient switch may be mounted on the "Hornet" for quick change from standard to constant potential characteristic, and vice versa. This is advantageous where the "Hornet" is used for general purpose welding as well as for use with "Honey Bee" stations.

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CRAFTSWELD RECEIVES ARMY AND NAVY "E"

On Thursday, September 21, 1943, the Craftsweld Equipment Corporation received the Army and Navy "E" Award for Outstanding Production. Presentation of the pennant was made by Capt. Edward Ellsberg, C.C., U.S.N.R., and the emblems by Col. Harrie D. W. Riley, C.E., U.S.A.

There was a considerable delegation from the New York Section of the AMERICAN WELDING SOCIETY to witness the ceremonies, which honored one of its past-chairmen, Charles Kandel, president of the company. Present also were the national secretary of the Society and the editor of the Journal.

Our readers will undoubtedly be interested in a brief description of the activities of one of its smaller member companies.

Craftsweld Equipment Corporation was organized in 1927 by its present management with a background of sixteen years of engineering, construction and manufacturing experience, the last ten of these years in the welding and cutting industry. Normal activities comprise the manufacture and distribution of welding and cutting equipment used in construction, maintenance and production.

This company pioneered in the development and improvement of commercial equipment for cutting steel under water, taking over in 1927 the Ellsberg underwater cutting torch first used in the raising of the U. S. Submarine S-51.

It originated and maintained for over fourteen years a service for cutting steel and cast iron under water on a contract basis. This service resulted in the use of underwater cutting as a standard practice in marine foundations and salvage. To meet the increased demands for this service, in 1940 the company released the equipment for outright sale. This equipment, together with our newly developed procedure for accelerated training of skilled operators, is now being used extensively by the United States, Great Britain and Russia.

The company also undertook the train of operators in its diving tank, and some of the men now hold key positions at The Panama Canal, in the Army Engineer Corps, and in the Navy Salvage Service, including the raising of the U.S.S. *Lafayette* (formerly the *Normandie*).

With the above activities, the company developed and began the manufacture and wide distribution of a new loudspeaker diving telephone which has very materially improved safety and performance in diving operations.

AIR CONDITIONING AND INDUSTRIAL REFRIGERATION BOOKLET

Controlled temperature, humidity and air cleanliness mean uniform quality, precision, fewer rejections and faster production, according to a new booklet on air conditioning and industrial refrigeration announced by Westinghouse Electric & Mfg. Co.

In machining work, optical goods grinding and assembly, flying suit storage, instrument assembly, citrus fruit concentration, spot welding, X-ray film developing, capsule manufacture, airfield traffic control and other industrial processes, the booklet shows how air conditioning and industrial refrigeration solve production problems.

This 20-page booklet illustrates and describes the exclusive hermetically sealed compressor, and traces its development from the 1932 models up to the present design. It also includes explanations and diagrams concerning the principles of air conditioning, and illustrates the complete line of Westinghouse equipment for air conditioning and industrial refrigeration, including models from 1 to 100 hp.

A copy of booklet 3AC-0201 may be secured from Westinghouse Electric & Mfg. Co., East Springfield, Mass.

STRUCTURAL FRAMEWORKS

Structural Frameworks by Clyde T. Morris and Samuel T. Carpenter, is an analysis of some of the more complex problems in the design of modern structural frameworks, including industrial plants and radio and transmission towers —with numerous examples of permissible simplification in approved methods of calculations. The book includes a chapter on Welded Design. 272 pages, 183 illustrations. Published by John Wiley & Sons, New York.

OFFICE OF WAR INFORMATION
War Production Board

A new publication, designed to aid business men and Government officials in obtaining information on all products, materials and service handled by the War Production Board will be issued by WPB every four weeks, it was announced today.

The publication, titled *Products and Priorities*, will include all information formerly contained in *Priorities* and in *Product Assignments*, both of which will be discontinued. A year's subscription of thirteen issues may be obtained for $2.00 from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. Single issues will be available at 20 cents each.

HOW TO MAINTAIN ELECTRIC EQUIPMENT IN INDUSTRY

Here in one volume are the tips every industrial plant is looking for on how to keep its electric equipment in top-notch condition. More than 500 illustrations, dozens of new tables, many hitherto unpublished charts and easy-to-use indexing combine to make this book more comprehensive than anything offered before.

Preventive-maintenance schedules and trouble-shooting charts are included on nearly all types of apparatus. Photos and diagrams give suggestions on what to do to get maximum performance and longest life out of your equipment, also indicate what constitutes good maintenance procedure and some of the troubles that may arise from improper care.

All the material has been prepared by men who have many years of practical field experience. The result is a volume that speaks the maintenance engineer's language.

Everybody engaged in electrical maintenance will want a copy of this new book for daily reference. You'll find it thoroughly practical—simple to refer to, and easy to apply.

There is a Section in the book on welding apparatus. Price $1.75, General Electric Co., Schenectady, N. Y.

ARE YOU THE MAN?

Successful manufacturer of resistance welders has need for a well-trained and experienced practical engineer, capable of handling all electrical problems in design and construction on various types of resistance welders.

The man we seek need not necessarily be a graduate engineer. We want a reasonably young man, over 30 years of age, married, with a family, and he must be ambitious and willing. We do not want a clock watcher.

This is a permanent job (not a position). Our postwar plans assure continued profitable employment. The right man can go a long way in this company.

Our plant is favorably located in one of the finest metropolitan areas situated in the West Central part of the country.

Write, giving full particulars, including employment record in detail, education, details of experience, family status, and enclosing photo or snapshot, which will be returned if requested. State what salary you will expect. Do not be afraid to write us a long letter. The more you tell us about yourself, the better consideration you will receive.

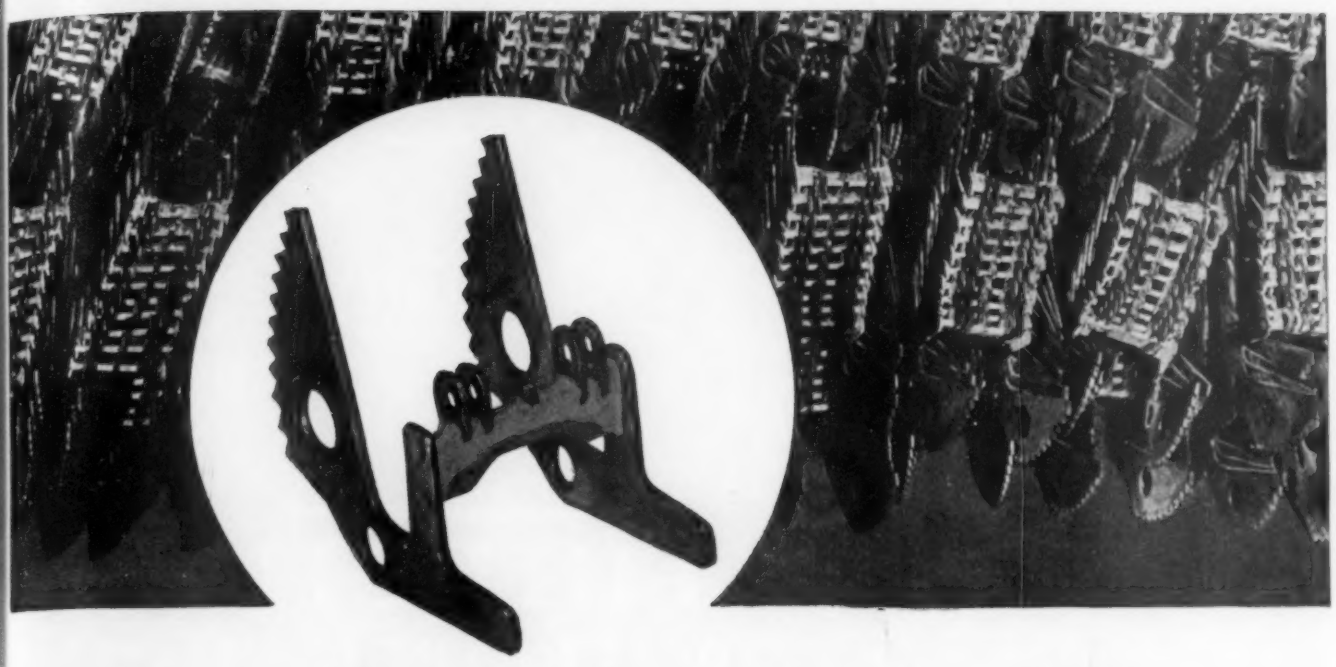
All replies will be held in strictest confidence. Our employees know of this ad. Address Box No. 130.

NET MONTHLY ADVERTISING RATES

Black and White — *Effective April 1943*

Space	One Insertion	Three Insertions	Six Insertions	Twelve Insertions
*Full Page	$120	$105	$95	$85
Half Page	70	60	55	50
Quarter Page	42	38	35	30
Eighth Page	30	25	20	18
*Inside Preferred	135	120	110	100

*10% Extra for bleed full pages. Color $40 Extra per color added.



Aircraft Brake Assemblies

welded with

Strong, Tough 997 Low Fuming Rod

The C. F. Rehbine Industrial Precision Welders of Detroit are bronze welding, on a production basis, the steel aircraft brake assembly illustrated. The job is done in two steps; first, welding of the cross arm components into one unit, and second, welding of the side members to the cross arm. Both operations are performed with the parts accurately aligned in fixtures. Now let Mr. Rehbine tell you *why* he selected Anaconda 997 Low Fuming Rod for this production welding job:

"*Anaconda 997 has very good tinning qualities and the braze is made with the least amount of fumes. The deposited weld metal has a smooth finish, requiring very little grinding. There is no porosity. We find that this rod enables us to obtain a high welding speed with a high weld strength.*"

For low temperature bronze welding jobs like this, for building up worn surfaces, or for the speedy repair welding of broken cast iron, steel, malleable iron or copper alloy parts, you'll find an economical answer in rods such as Anaconda 997 Low Fuming and Tobin* Bronze. Publication B-13 tells more about these and other Anaconda Welding Rods. Ask for a copy.

*Trade-Mark Reg. U. S. Pat. Off. 4290

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ANACONDA

Anaconda Welding Rods

WELDING GOES TO JAIL

Arc Welding and Cutting Saves Sparks, Nev., City Hall from being Partially Dismantled for Installing New Jail

When the new city hall at Sparks, Nev., was being built and the all-steel jail which was incorporated in the plans had not arrived for installation, construction of the building had to go on.

Photograph courtesy The Hobart Brothers Co., Troy, Ohio

The building was near completion when the jail finally did arrive, and the question in the mind of Chief of Police A. J. Bassemier was how to get the jail into the new building without having to tear part of it down.

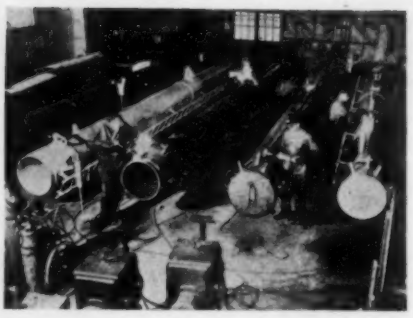
Immediately contacting the Sparks Welding School, Mr. David E. Williams, instructor at the school got the students in welding together and with an arc welder went down to the city hall to look the situation over.

The jail had been originally constructed mostly by arc welding, so the welding students from the school started cutting the sections into smaller ones that could be moved into the building. The pieces of the ceiling of the jail were of flat steel sheets and these were easily cut apart and welded into position iuside the building. After the bars and doors had been welded and fastened into position, Chief Bassemier had the students weld all the bolts and nuts as added precaution against prisoners breaking out of the jail.

The entire job was completed in 25 hr. of welding time and 5 hr. for cutting; 150 lbs. of $^1/_8$-in. and $^5/_{32}$-in. electrodes were used. The material was the only cost involved to the City of Sparks, as the welding was done by the students of the welding school and no charge was made for their services.

PRODUCTION WELDING KING POSTS FOR LIBERTY SHIPS

Fabricating, rolling and welding $^5/_8$-in. steel plate into king posts for Liberty ships created quite a problem until proper facilities could be made to put them on a production basis.



Courtesy Hobart Bros. Co., Troy, Ohio

Weber Showcase & Fixture Co. of Los Angeles have constructed automatic rotating devices which turn the king posts while seams are being welded, and also during the welding of the ladder and fittings. These king posts are 30 ft. long, welded in three sections and reinforced with an extra $^1/_2$-in. plate band where the boom steps are attached. When completed each king post weighs 5800 lb.

Eighty-eight pounds of welding electrodes are consumed in the welding of each king post, using 400-amp. welders.

Castolin Eutectic®

EUTECTIC*

(Means Lowest Binding Alloy)

LOW TEMPERATURE WELDING

FREE LATEST

WELDING DATA BOOK

Contains the Answers to Hundreds of Wartime Welding Problems

Contains vital facts to speed up your production and cut your welding costs with Eutectic Low Temperature Welding. Also valuable information on:

Production Welding

Joining dissimilar metals and dissimilar gauges without burning • Design simplification • Substitution of butt joints for lap joints, etc.

Salvaging Defective Castings

Effectively at low cost • Completely machinable, invisible welds • Ideal for thin walled or heavy castings in all metals.

Maintenance Welding and Tool Salvaging

"Hard-to-get" tools costing up to $180 and requiring up to 50 weeks for delivery, salvaged for re-use in a few minutes at a cost of but a few cents.

Ordnance Plant Engineer writes: "Book very instructive, send ten more for distribution."

Write for Welding Data Book E

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Use Ampco-Trode for manufacturing or maintenance. Deposit the same high-performance bearing overlay on your job that has found wide acceptance in U. S. arsenals, ordnance, and war production plants.

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DEPARTMENT WJ-11

MILWAUKEE 4 WISCONSIN

AMPCO

The four posts shown in photograph are in different stages of production. From left to right, the first shows completed king post with ladder and fittings welded on. Second post rests on the rotating device while the welders weld on the fittings. Third post is being welded at the seams while another workman is grinding a seam preparing it for painting. The fourth post is receiving its coat of protective paint and will soon be ready for shipment to one of the shipyards for installation on Liberty ships.

NOVEL STRUCTURE BUILT BY INSTRUCTORS ACCUSTOMS STUDENTS TO UNUSUAL WELDING POSTURES

The ingenuity of Cliff Davis and Ed Legner, welding instructors at Associated Shipbuilders, Seattle, Wash., in building a novel device to enable students to simulate actual positions encountered in arc welding cargo and fighting ships, was graphically brought out in data sent to A. F. Davis, vice-president of The Lincoln Electric Co., Cleveland, Ohio.

Faced with the problem of turning out students as quickly as possible to meet the huge demands for first-class welding operators, these welding school instructors conceived and built an enclosed structure resembling a "double bottom" section of a ship (see Fig. 1) so that trainees could test their skill under actual job conditions.

Constructed of scrap steel and pipe standards with a wooden cover, this unique structure has adjustable jigs inside the main frame which hold practice plates. The tank-like enclosure includes four universal joint legs and a rocker on the base which permits the work to be positioned at practically any angle (see Figs. 2, 3, and 4).

Confined in tight and unusual positions, the student welder can practice his trade under almost any condition which he must face on a real job such as the confined positions shown in Figs. 5 and 6.

A close-up of the adjustable leg joint arrangement which affords good support of the unit even when tilted at an unusually steep angle is shown in Fig. 7.

According to word received in Davis' letter, "the welder student is given a chance to demonstrate his ability when he thinks he's ready to go out on an actual ship-welding job. In many instances he finds he needs more training after a session inside the 'double bottom' and consequently a lot of time and trouble is thereby avoided."

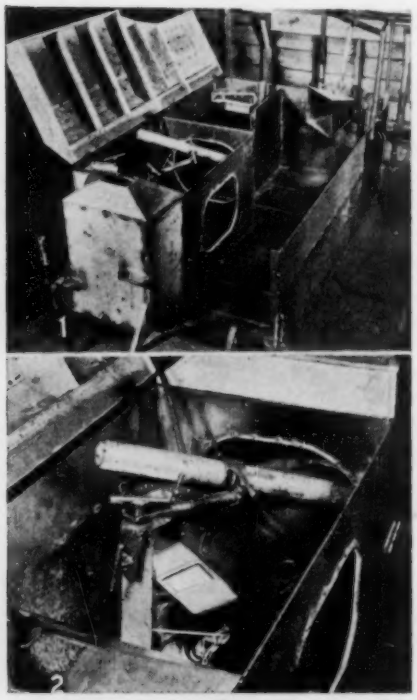


Fig. 1—Plan View (Overall)

Fig. 2—Position Facing Jointed Jig for Vertical and Overhead Fillet Welds

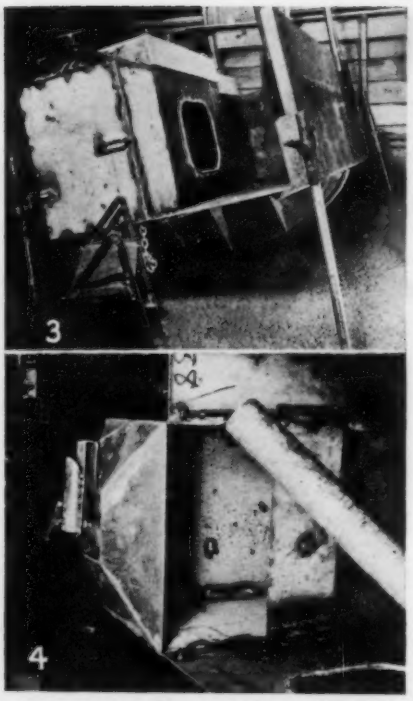


Fig. 3—Angle for Tilting (in All Directions) with Adjustable Legs and Rocker Under Center of Tank

Fig. 4—Jig for Overhead One-Hand Welding and View of Sliding Door

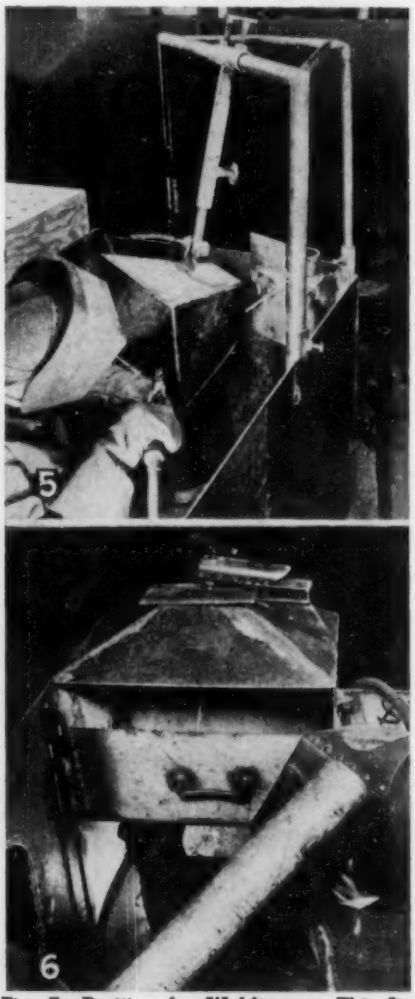


Fig. 5—Position for Welding on This Jig with Sliding Door in Position

Fig. 6—"Confined Position" Jig, Adjustage to Any Position Making the Job Easy or Difficult

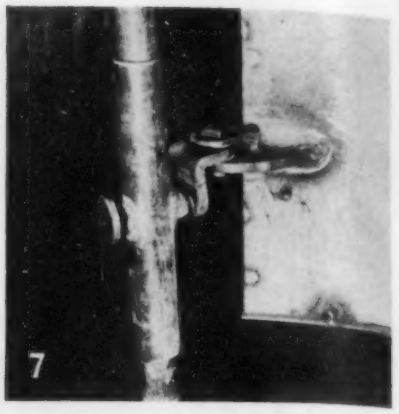


Fig. 7—Detail on Adjustage Leg Joint Making Possible Good Support When Tank Is in Off Positions

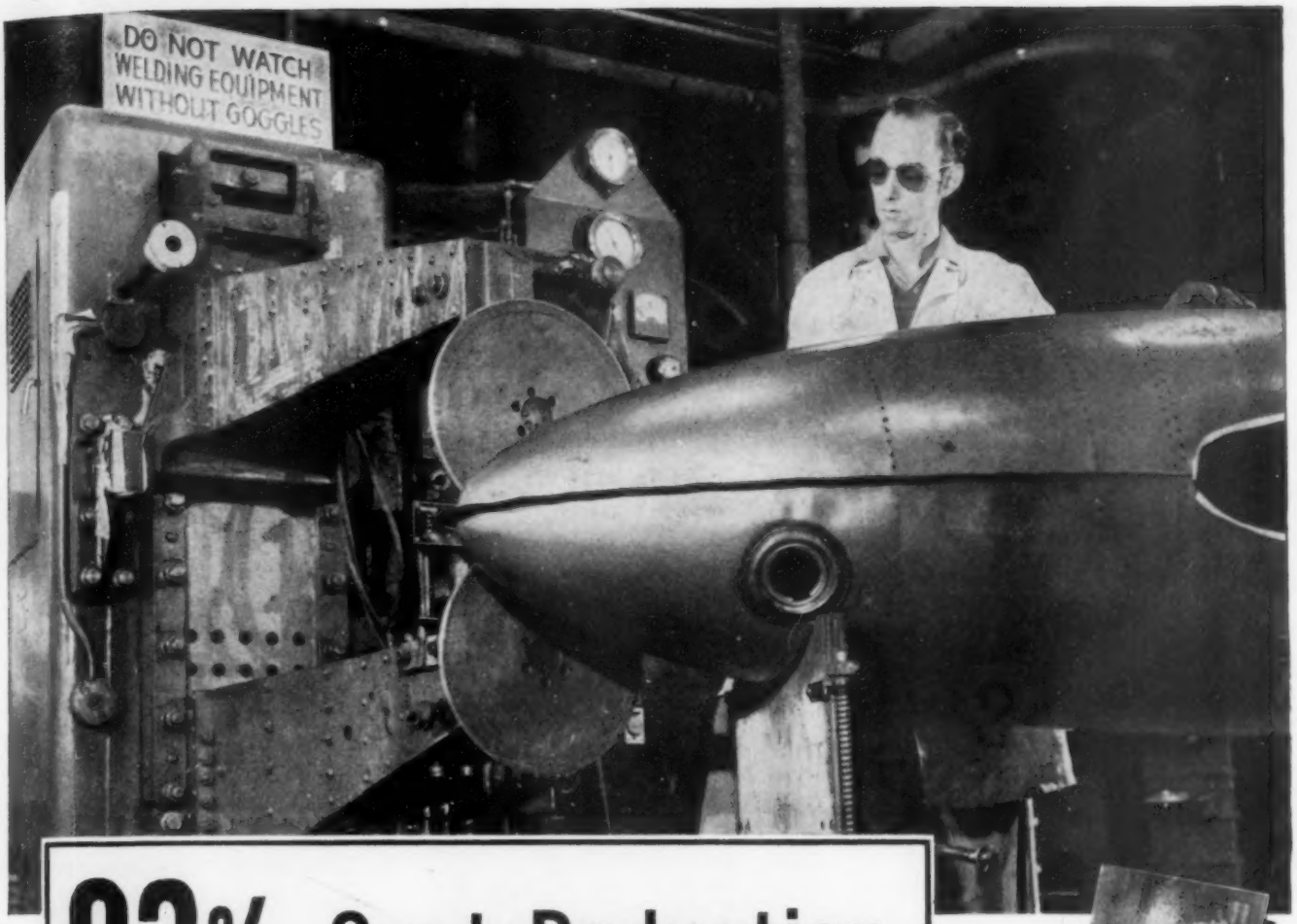
"BIG INCH" PIPE LINE TO HAVE "BIG BROTHER" COMPANION

"Big Inch," the new pipe line from the southwest that reached its eastern terminal at Phoenixville, Pa., late in July, will have a "Big Brother" that will greatly assist in solving the gas and oil shortage in the east.

Already another pipe line is started, paralleling the "Big Inch," being laid within a few feet of each other, that will almost double the amount of oil that will be delivered to the east coast via pipe line. This new 20-in. line is being constructed in much less time than was required for the "Big Inch," as much of the excavating, clearing and grading work will not have to be repeated. "Big Inch" was completed only a few days short of a year from the day the first weld was made at Longview, Tex., a record that will, in all probability, be broken with this new pipeline.

When all lines are completed oil and gas will flow in sufficient quantities to relieve the shortage on the eastern coast line.

While no figures can be given on the new 20-in. pipe line, one can estimate the added amount of oil that will be sent to the east by reviewing the capacity of "Big Inch." The "Big Inch" was constructed of seamless steel pipe with walls $^{3}/_{8}$ in. thick. Its capacity is 300,000 barrels of oil a day, equivalent to the daily capacity of about 25,000 railroad tank cars. Twenty-nine booster stations at 50-mile intervals are used to force the oil through this 1400 miles of pipe line.



83% Cost Reduction *with* ELECTRONIC SEAM WELDING

How Lockheed Saves Man-hours and Material in Building This Fuel Tank

Here is the story as told by R. A. Von Hake, vice president in charge of manufacturing at Lockheed Aircraft:

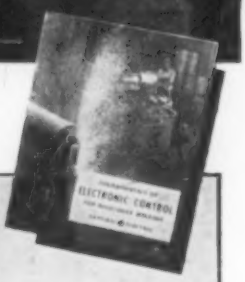
"The use of resistance welding in aircraft is increasing because of improved controls, welding machines, cleaning processes, and process control. This 150-gallon droppable fuel tank was formerly made of aluminum alloy materials. The bulkheads were spot-welded to the skin, but the two halves were torch-welded.

"Minor redesign, and changing the material to 1010 steel, made possible the change from torch welding to resistance welding, as well as the use of time-saving welding fixtures and other special equipment. As a result, the cost of the tank has been reduced to approximately *one-sixth* the former amount."

The seam welder shown in the photograph is equipped with General Electric *electronic* control. We have a complete line, and G-E electronic-control specialists will help you select and apply the right controls. Contact any G-E office. *General Electric, Schenectady, N. Y.*

ELECTRONIC CONTROL

BUY WAR BONDS



FREE

G.E.'s new 44-page manual, "Fundamentals of Electronic Control for Resistance Welding". Gives basic information on electronic control for spot, seam, and special forms of resistance welding. Written by leading G-E electronic-control engineers. Send the coupon for your copy.

General Electric, Sec. G645-24
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Please rush me your new 44-page manual, "Fundamentals of Electronic Control for Resistance Welding," No. GET-1170.

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GENERAL ELECTRIC

Courtesy The Hobart Brothers Co., Troy, Ohio

The rate of flow through "Big Inch" is 4 1/3 miles per hour and it takes 14 days to make the complete trip from Longview, Tex., to New Jersey.

Much of the experience gained in building the "Big Inch" will be used to great advantage in laying this 20-in. line. Heavier steel will be used under all large rivers as a safeguard against washouts during high waters in winter.

WELDING DISTRIBUTORS ASSOCIATION

On September 20th to 22nd, executives of welding equipment and supply houses met at the Lake Shore Club of Chicago for the purpose of forming an association of welding distributors. These men came from all sections of the country and were representatives of houses with a national reputation in the welding supply field.

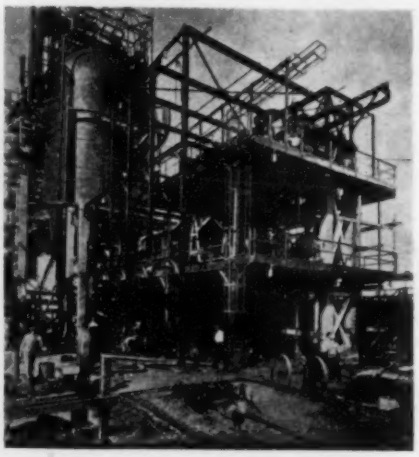
The group selected the name, "Welding Distributors Association," drew up a constitution and set of by-laws which were voted upon and adopted unanimously by the conferees. At the same time officers and directors of the new organization were elected. The officers, who are also directors, are: *President*, T. A. Jones, Arc-Way Equipment Co., Philadelphia; *Vice-President*, Mark Cobb, Welding Engineering & Sales Corp., New York; *Secretary-Treasurer*, W. H. Simmons, Welding Sales & Engineering, Detroit. Also elected directors are: E. S. Daniels, Victor Equipment Co., San Mateo, Calif.; F. P. Kohlbry, Machinery and Welder Corp., St. Louis, and C. E. Whitehead, Wessendorff, Nelms & Co., Houston. Some of the other firms represented at the meeting were: Jack B. Dale, Briggs-Weaver Machinery Co., Dallas; W. A. Haseltine, J. E. Haseltine & Co., Portland; and E. A. Filley, Manufacturers Rubber & Supply Co., Akron.

The main purpose for the founding of this national association, according to a spokesman for the group, is to provide some means whereby distributors of welding equipment and supplies may freely exchange information about problems common to all. The association, this spokesman added, also plans to take an active part in bringing to the attention of all industry, now and in the postwar period, the many benefits which industry can derive by a wider use of welding.

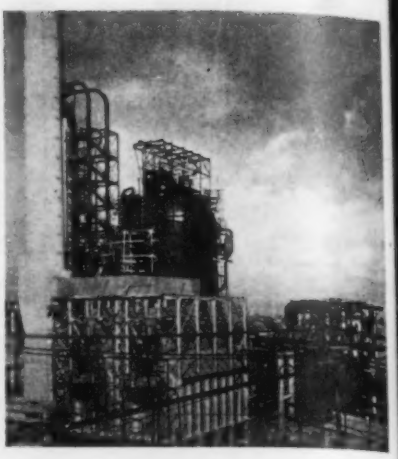
At the closing of this initial session of the new Welding Distributors Association, the group had as their guests C. I. MacGuffie, manager of G-E welding equipment division, and K. H. Runkle, assistant manager of G-E industrial department, who spoke on current developments in the welding field and outlined some aspects of the future postwar market for both equipment and supplies.

FRACTIONATING TOWER

The accompanying illustration gives views of completed 33-ft. diameter vacuum fractionating tower which is one of the



largest individual units of equipment ever used in an oil refinery. This tower was constructed by the use of arc welding which saved $36,860 as compared to a



riveted unit and was erected in two months less time. Welding permitted the use of steel bubble trays instead of cast iron with a saving of 30% in the cost of the trays alone.

A paper describing the design and construction of this tower was submitted in the recent James F. Lincoln Arc Welding Foundation $200,000 Progress Award Program by Egon F. Brummerstedt, Mechanical Engineer, Petroleum Refinery Division, Foster Wheeler Corporation, New York, N. Y.

TURBOSUPERCHARGERS WELDED

The turbosupercharger, the engine accessory that enables our fighting aircraft to surpass those of all other nations in high-altitude performance, is subjected to such extreme operating conditions that its manufacture requires a great deal of high-precision work. Prior to the war, when turbosupercharger production was small, a small staff of expert mechanics at General Electric made the complete unit—it was felt then that all turbosuperchargers had to be made that way.

Today, however, the needs of the war program have led the way to tremendously accelerated turbosupercharger production on an assembly-line basis. They are, however, still being made with the same precision and attention to exceptionally close limits that was early found necessary, much of the work being done by women.

Welding Distributors Association Meeting

PAGE *Welding* ELECTRODES

WELDING STAINLESS?

Then you know how important it is that the metal deposited in the weld shall equal the Stainless you are welding. PAGE took away all uncertainty in that regard when they, in cooperation with the largest manufacturers of Stainless Steel, produced a complete range of PAGE-ALLEGHENY STAINLESS STEEL ELECTRODES—a range so complete that from it you can select the exact electrode for your work.

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Because Stainless Steel stands so high on the list of critical materials, it is more than ever necessary to see to it that the electrode you are able to get will give you the proper metal in the weld. And it becomes even more essential to see that you get electrodes of the proper diameter and that your men waste none of them.

PAGE STEEL AND WIRE DIVISION

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ESSENTIAL PRODUCTS . . . TRU-LAY Aircraft, Automotive, and Industrial Controls, TRU-LOC Aircraft Terminals, AMERICAN CABLE Wire Rope, TRU-STOP Brakes, AMERICAN Chain, WEED Tire Chains, ACCO Malleable Castings, CAMPBELL Cutting Machines, FORD Hoists, Trolleys, HAZARD Wire Rope, Yacht Rigging, MANLEY Auto Service Equipment, OWEN Springs, PAGE Fence, Shaped Wire, Welding Wire, READING-PRATT & CADY Valves, READING Electric Steel Castings, WRIGHT Hoists, Cranes, Presses . . . *In Business for Your Safety*

An outstanding example of operations of this kind is illustrated in the accompanying photograph taken at General Electric's Fort Wayne supercharger plant.

Stitching with an Electric Needle—Electronically Controlled Resistance Welding Machine Being Used to Spot Weld Supercharger Parts at General Electric's Fort Wayne, Ind., Plant.

FIFTY-FOOT WELDED VESSEL*

This large vessel recently completed by Leader Iron Works, Inc., Decatur, Ill., had to measure 50 ft. long, no plus, no minus, when finished and with twelve 4-in. flues all welded in place. Flue sheets had to be within 90° plus or minus one minute of the shell center line or tube sheet center line.

The vessel was made in seven courses, each course turned up square on centers in a lathe and beveled 30°. Then four tram marks were put on each end of course to be used for fit-up purposes. To fit up face plates in the floor and large angle irons were used to hold flue sheets. A water level was used for leveling.

When finished with our work the customer checked with surveyor's instruments and found, as we did, that the vessel was exactly 50 ft. Flue sheets were absolutely parallel to one another and the vessel itself was within the $^{5}/_{16}$-in. out-of-round tolerance that had been allowed. No facing was necessary after welding; $^{5}/_{32}$-in. electrodes were used during the welding.

* This Article was taken from a winning entry in Hobart Brothers Co. Arc Welding News Contest.

PRESIDENT'S ADDRESS TO THE MEMBERS OF THE AMERICAN WELDING SOCIETY

By K. L. Hansen

It is somewhat humiliating for a president to begin his annual report to the members of the organization which elected him with an apology, yet, in this instance that appears to be in order. Your president realizes he has fallen far short of measuring up to the opportunity for service which his elevation to the presidency provided.

Poor health at the beginning of the fiscal year aggravated and prolonged by a tragic accident, necessitated reducing my activities, including those pertaining to the American Welding Society, to a minimum. The discrepancy between desire and ability to perform has been a source of keen disappointment, especially in one particular. Almost all invitations to visit Sections had to be declined and thus a splendid opportunity to be an inspiration and help to the men in the field, as a president should, was lost.

However, no apology is offered for the activities of the Society during the year. The report of the Secretary shows a membership of *6661*, representing a net increase in membership of 31%, a creditable showing and it is especially gratifying that the greater increase, 44%, is in the full member classification. The addition of six new sections with two more in the organization stage is an eloquent testimony to the effective work of the National Membership Committee.

The attitude of temporary officers in carrying on organization work of new sections has been exceedingly encouraging to the president. They have generously overlooked his inability to give assistance by personal contact and have carried on enthusiastically in spite of it. The letters received from some of them have been a real inspiration in a most trying time.

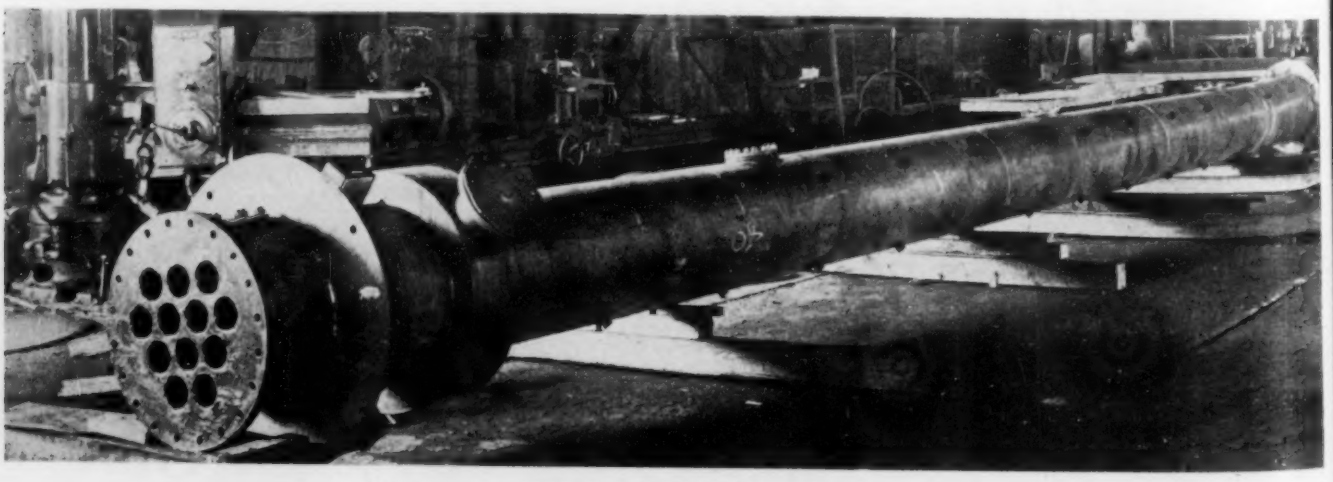
As pointed out in the reports of the Secretary and Chairman of Outline of Work Committee the technical work of the Society has been directed primarily toward aiding the war effort. This aim is reflected in the technical papers in the Journal, in the Standardization work of the Committees and the programs of the Section meetings.

Program Chairmen of Sections have had a rather difficult time of it. Good speakers are at a premium and frequently a carefully prepared program is subject to a sudden change because a scheduled speaker has been forced to cancel an engagement at the last moment on account of urgent war work. However, they have carried on manfully and as pointed out by the Secretary, most of the Sections have had very successful meetings.

This year, as in other years, research has occupied a place of pre-eminence in Society activities. It is, therefore, of interest to note the reorganization of the Welding Research Committee and its functioning under a new name The Welding Research Council. Under its direction and coordination are carried on the very important research projects in the laboratories of educational institutions and industries.

Because of his inability to carry on normally for the greater part of the fiscal year the president has been in a unique position, the fact is that he would not have been able to carry on if it had not been for the assistance rendered by his associates in the Society. This has been unstintedly given by his fellow officers, especially the First Vice-President, the Treasurer, Headquarters staff and the Chairman of the Committee on Outline of Work.

The fine spirit of cooperation on the part of everyone whom I have come in contact with in connection with the Society has resulted in the successful year and has been greatly appreciated.



Fifty-Foot Welded Vessel

If You Want to Be Shown . . .

IF you want to be *shown,* definitely and conclusively, that SMITHway Certified Welding Electrodes can give lower welding cost and *better welding results* in YOUR plant before any further discussion, then you speak our language and we speak yours.

That's exactly the way we would feel about it if we were on your side of the desk and you were on ours. We would want to be *shown!*

The reason we feel so completely confident that SMITHway Certified Welding Electrodes can prove their case in your own plants is that *we use millions of pounds* of them *every year.* Welding is the *vital factor in everything we do . . .* and welding electrode *quality* and *uniformity* are vital factors to the success of *any* welding operation.

Mild Steel . . . High Tensile . . . and Stainless Steel
WELDING ELECTRODES
made by welders . . . for welders

SMITHway AC Welding Machine: *no arc blow; reduces spatter losses; effects worthwhile overall power saving; gives more good welds per man-hour.*

SMITHway Welding Monitor: *cuts time and cost of training welders as much as 33⅓%; automatically signals operator when the correct speed of travel and length of arc are being maintained.*

A. O. SMITH *Corporation*

MILWAUKEE • WISCONSIN • HOUSTON • TEXAS

NEW PRODUCTS

The Society assumes no responsibility for the validity of claims in this Section

UNDERWATER CUTTING TORCH

Victor Equipment Co., San Francisco and Los Angeles, is now introducing an improved Underwater Cutting Torch, Model 3900.

The manufacturer claims that this improved design offers to divers the following added conveniences:

1. The Air Mantle is so designed that it limits the annoying slagging of the tip and adjustments can readily be made under water without irretrievably losing parts.

2. The gas control valves are so located and so designed that they can be more easily manipulated when the diver wears heavy gloves and operates in murky water.

3. The torch will start the cut and will do the actual cutting with heretofore unaccustomed speed.

4. The torch is more easily maintained in service and occasional reconditioning can be undertaken with a minimum of previous skill or special tools.

A comprehensive descriptive bulletin, with many excellent illustrations, is available to divers and engineers.

TRAIL-BLAZING ARC TO SPEED PLANE WELDING

A high-voltage "trail blazer" that cuts an electric path through air has been developed to speed welding of the delicate aluminum and alloy steels used in warplane construction.

Called an "arc stabilizer," the new device is an assembly of coils, condensers and transformers built into an electric welding machine. Part of the stabilizer is a spark gap oscillator, a device used in radio transmitters back in the crystal set era.

The stabilizer, according to C. L. Denault, engineer at the Sharon Plant, produces electricity which has a high voltage, or electrical pressure, and changes its direction of flow many thousands of times a second. This type of electricity has the ability to leap through the air from the tip of the welding rod to the airplane metal being welded. It literally knocks electrons off the atoms of gas in the air. When the air is in this condition, it conducts electricity more easily. Then the regular welding current jumps from the rod to the metal along the path created by the trail blazer.

Until the stabilizer was developed electric welding of plane parts required great skill. Low currents had to be used to prevent burning of the thin metals and this made it difficult for the welding operator to start the electric arc and keep it glowing while he made the weld.

Fig. 1—High Voltage Arc to Speed Plane Welding

To speed fabrication of fuselages, engine mounts and other parts of warplanes, engineers of the Westinghouse Electric & Mfg. Co. have devised an "arc stabilizer" that blazes an electrical path through the air and prevents extinguishing of the match-head size arc needed in electric welding of plane parts. Engineer William E. Pakala is shown above testing a laboratory model of the stabilizer. This development will enable newly trained aircraft workers to weld delicate alloy steels and aluminum with electricity.

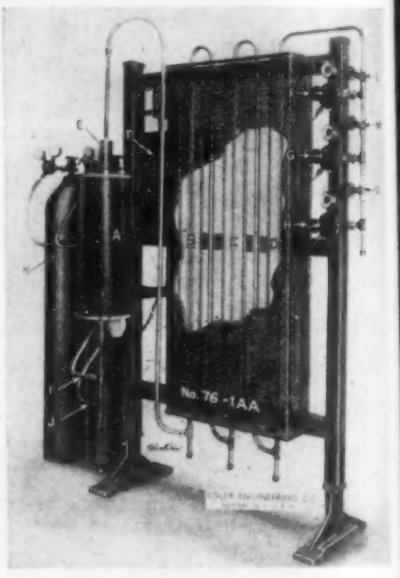
Aircraft welding must be done with low currents, the piece being welded must be kept comparatively cold so no holes will be burned into it and the rods used are often as thin as a pipe cleaner. The arc itself is about the same size as the head of a safety match. Under these conditions, the arc tended to go out each time the regular welding current alternated or changed its direction of flow. This tendency can now be counteracted by the trail-blazing electricity which is turned on by a switch in the holder that grips the welding rod. When the operator is ready to weld, he flicks on the switch and holds the tip of the rod near his work. The high voltage electricity leaps across the gap and the welding current follows. The "trail-blazing" current keeps flowing until the weld is finished to prevent the main arc from being extinguished.

The stabilizer was developed by Mr. Denault with the assistance of Engineer William E. Pakala, of the East Pittsburgh, Pa., Westinghouse plant. After several experimental stabilizers were successfully tested on the production lines of an Eastern aircraft plant, the Sharon works undertook production of the new device, building it into a.-c. welding machines.

HYDROGEN GAS PURIFIER

Removing residual oxygen, moisture and other active contaminating gases from commercial hydrogen is not only essential for many technological and chemical processes, but also sometimes a fundamental factor, for instance: to prevent oxidation in steel-heating furnaces; to reduce all metallic parts in the production of electronic tubes; to weld or braze metals in an atmosphere of pure hydrogen and also for hydrogenation in various food industries.

The accompanying illustration shows an electric hydrogen gas purifying equipment, which is manufactured and marketed by the Eisler Engineering Co., Newark, N. J.



The hydrogen gas, to be purified under a pressure of 30 to 50 psi., passes first through an electrically heated furnace, *A*, which holds a calorized seamless steel tube, *E*, containing small pieces of pure copper for removing oxygen. Then the gas moves progressively through three glass containers, *B*, *C* and *D*—each 4 ft. long and 3 in. in diameter—filled with purifying ingredients such as caustic potash or sodium lime. From the last glass tube, *D*, the purified gas enters a manifold with three outlets, *L*, *M* and *O*, leading to three different supply lines, from where it may be directed to small furnaces or other places where purified hydrogen is required. Each of the supply lines is controlled by one adjustable diaphragm reducing valve, *F*, *G* and *H*, providing a possible reduction of pressure down to 1/2 psi.

New Data on Spot Welding of Nickel, Monel *and* Inconel

Result of a two year research program at the Welding Laboratory of the Rensselaer Polytechnic Institute

Definite information on the spot welding of Nickel, Monel* and Inconel* was presented last October at the Annual Meeting, A.W.S., in Philadelphia. Reprints of this paper, by Wendell F. Hess† and Albert Muller‡, are now available.

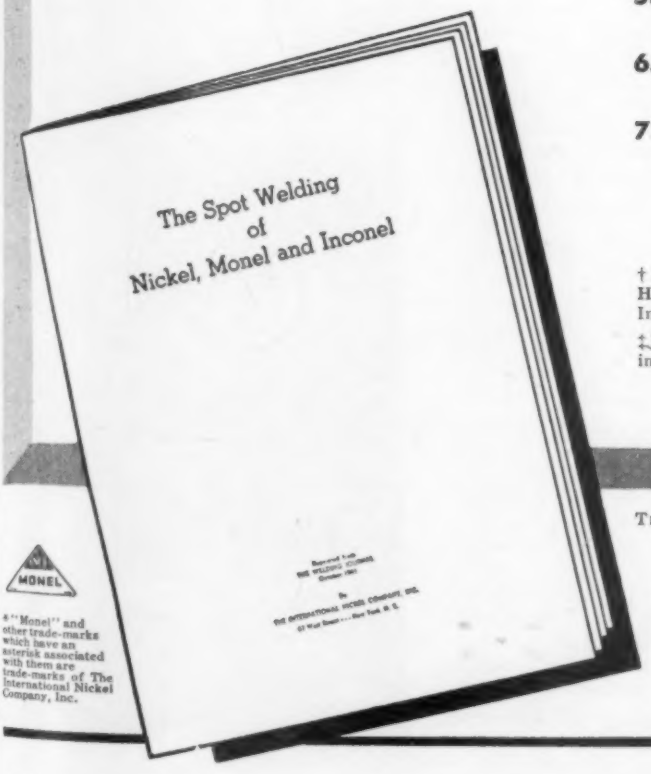
The results reported include data on:

1. **Recommended welding conditions for producing sound spot welds in Nickel, Monel and Inconel sheet.**
2. **Strength of spot welds.**
3. **Recommended electrodes.**
4. **Control of energy input.**
5. **Limit of permissible distortion, and method of measuring it.**
6. **Load-distortion characteristic curve for single-spot lap-weld specimens.**
7. **A fast, efficient method for evaluating quality of spot welds made in shop.**

For your copy of this paper please mail the coupon below

† Associate Professor of Metallurgical Engineering and Head of the Welding Laboratory, Rensselaer Polytechnic Institute, Troy, N. Y.

‡ Research Fellow, Department of Metallurgical Engineering, Rensselaer Polytechnic Institute, Troy, N. Y.



* "Monel" and other trade-marks which have an asterisk associated with them are trade-marks of The International Nickel Company, Inc.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall Street, New York, N. Y.

Gentleman: Please mail ..... copies of your new bulletin, "Spot Welding of Nickel, Monel and Inconel" to:

Name..... *Title*.....

Company .....

W.J. 11-43

Address .....

The electric oven, *A*, operates on 110 or 220 volts. An auto transformer, *T*, is provided for regulating the heat, which never should be over a maximum of 1200° F. Best results are reported at 980° F. Under this temperature and the forementioned pressure, the clarifying materials react rapidly and the complete removal of all extraneous substances in the commercial hydrogen gas is promptly assured.

Two steel cylinders, *K*, containing the hydrogen gas under high pressure are supplied to maintain continuous work. Both are independently connected through two flexible metal hoses, *I* and *J*, and a brass pipe line to the electric furnace.

All parts of the equipment are mounted on a frame of heavy square steel tubing. Removable caps on top and base of the glass dryers permit easy filling with chemicals and occasional cleaning of these containers without any trouble.

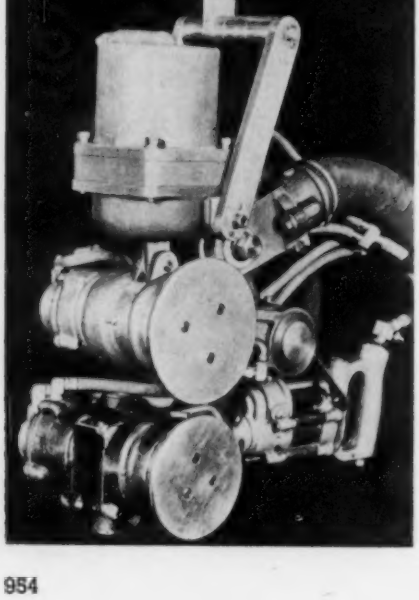
The glass dryers, *B*, *C* and *D*, are made of heavy transparent Pyrex glass in order to resist the conditions of the chemical process and simultaneously to be able to control the correct chemical reaction.

Hydrogen gas purifiers are manufactured in different sizes depending on the amount of gas required.

PORTABLE SEAM-WELDING GUN

A new development in seam welding in the form of an air-operated portable gun with which parts that are too big to "take to the machine"—and also large assemblies which are mounted in stationary fixtures—can be seam welded, has been announced by Progressive Welder Company, 3050 E. Outer Drive, Detroit 12, Mich. This is believed to be the first practical portable seamwelder available to industry. It is already in use welding 22-ft.-long seams on disposable light-weight gas tanks.

The machine has been designed for welding steel up to two thicknesses of 20 gage, including stainless steels. The gun



is universally suspended and can be swiveled about so that the operator can weld in almost any direction—horizontally or vertically.

Features of this new seam-welding gun include a head operated by an air motor using 42 cu. ft. of air per minute under load. The motor is rated at 2 hp. when run at a constant speed. Its standard speed is between 48 and 52 in. per minute, using standard rolls—or wheels. A governor regulates the speed of the air motor.

When the seam-welding gun is in operation, the air passing into the handle runs the motor. Pushing the control button—which is located on the guide handle at the right of the gun—operates a solenoid switch, letting the air into the cylinder on the gun. This air cylinder has a diameter of $4^1/_2$ in., which is large enough to provide a maximum pressure of 1400 psi. with 90 lbs. of line pressure. This permits the seam welding of stainless steel.

Standard equipment provided with this seam-welding gun includes a pressure switch, a solenoid air valve, control relay, air line strainer, lubricator and pressure gage, motor, air-regulating valve, shut-off valve, pressure fittings for lubricating the moving parts of the gun, and an adjustable counter-balancing hanger which supports both the gun and the transformer. The transformer is rated at 100 kva., is water cooled, and operates at 440 v.—60 cycles. The recommended maximum duty is 2 cycles "on" (welding); and 4 cycles "off" (cooling). The cable is 750,000 cm. concentric kickless type.

PRESSURE REGULATOR

Victor Equipment Company, San Francisco, announces a new pressure reducing regulator, Model No. 4000-1000 Pilot Type, combining several interesting features.

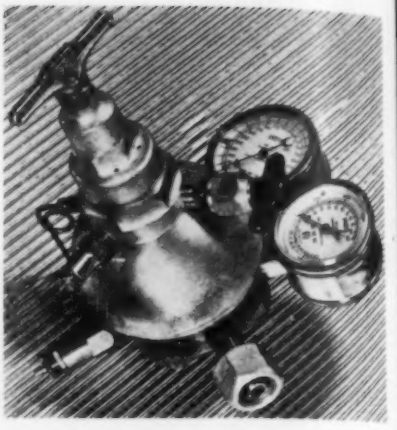
This particular regulator is available for inlet pressures up to and exceeding 4000 psi. and for delivery pressures up to and exceeding 1000 psi. Designed particularly for the purpose of refilling to 400 and 800 psi., respectively, smaller cylinders from cylinder manifold systems, this regulator will fully meet any similar requirements.

The manufacturers claim the following advantages for this regulator:

1. *Greater pressure accuracy.* A specially designed diaphragm is gas loaded instead of spring loaded and is so constructed that damage to or rupture of that diaphragm is virtually impossible.

2. The loading pressure of the main regulator is *controlled by a built-in pilot regulator*, the tension screw of which is so arranged that it will not permit a diaphragm loading pressure beyond a predetermined maximum. Since the major regulator's diaphragm is controlled by this pilot regulator, any pressure loss is automatically compensated for by this regulator. Should the loading pressure exceed a desired maximum, an adjustable relief valve will reduce this pressure to normal.

3. If the operator wishes to diminish a previously set operating pressure, he

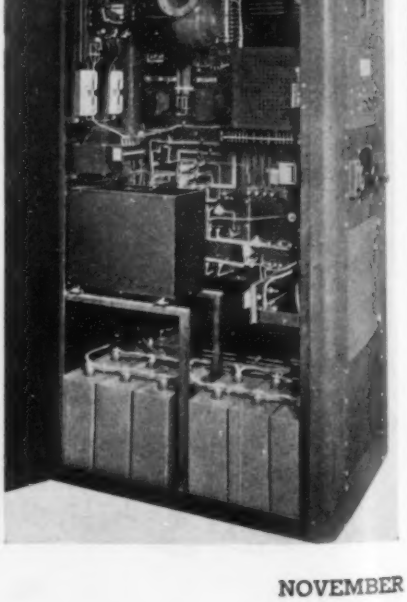


merely releases the tension screw of the pilot regulator and exhausts the dome pressure by a *non-leak release valve*.

Victor Equipment Company produces other types of "Gas-O-Dome" regulators up to primary and delivery pressures of 5000 psi. and higher. A "Gas-O-Dome" regulator of similar design is also produced for maximum hourly gas requirements exceeding 100,000 cu. ft. for working pressures up to 150 psi.

SINGLE-PHASE CAPACITOR WELD UNIT

The new Model 135 Weltronic single-phase Revers-O-Charge capacitor weld unit has been designed to fill the need for a smaller welding control incorporating many of the important features found only in the larger three-phase Weltronic units. The Model 135 uses from one to twelve 120 microfarad condensers giving a variable capacity of from 120 to 1440 microfarads, and as in the three-phase Revers-O-Charge, the reversed counter voltage of the discharging welding transformer is used to partially recharge the condenser bank after each weld. In this way the line surge at the beginning of each charge is considerably diminished.



Both discharge and recharge of the condenser bank are accomplished entirely by electronic means, and without the use of moving parts between the condenser bank and the welding transformer.

Charging voltage is electronically maintained to within a plus or minus 2%. Under-voltage and over-voltage relays can be provided where this additional protective feature is desired. These additional relays prevent the discharge of the condenser bank until needle point accuracy of the charging voltage is reached. Discharge is likewise prevented if an overcharge of the condensers occurs.

Maximum operator safety is insured by a shorting bar which discharges the condenser bank when the power is shut off, the service doors opened, or when changing the condenser capacity. The unit has a dead front and a swing-out sequence panel. The mushroom head "start" button prevents accidental operation of the unit.

Floor space occupied measures approximately $2\frac{1}{2}$ x 3 ft. The Model 135is 6 ft. in height. It is manufactured by Weltronic, 20,735 Grand River, Detroit 19, Mich.

SECTION ACTIVITIES

BOSTON

The first meeting of the season was held on October 11th at the Engineers' Club, Boston, with a large attendance.

Lieutenant-Commander L. Burton Benjamin, a member of one of the first Seabee outfits participating in stategic engagements of Guadalcanal area, related some interesting experiences.

Mr. George A. Ross, Welding Engineer, General Electric Co., Lynn, Mass., spoke on "Atomic Hydrogen Welding." He discussed its fundamentals, applications and possibilities, supplementing his talk with lantern slides.

General Electric Co.'s new sound film in full color, "The Inside of Atomic Hydrogen Arc Welding," was shown.

CHICAGO

The new season started with a meeting on Sept. 17th at 7:30 P.M. in the auditorium of People's Gas Light and Coke Co., 122 So. Michigan Ave. A paper on "Aircraft Welding" was presented by W. S. Evans, Materials and Process Engineer, Curtiss-Wright Corp. A pre-meeting movie entitled "B-10 Aircraft" was shown through the courtesy of Douglas Aircraft Co.

CLEVELAND

The first regular meeting of the Cleveland Section for the new season was held on October 13th at 8 o'clock at the Cleveland Engineering Society.

The main feature of the evening was a paper entitled "The Control of the Arc-Welding Process for Mass Production of Heavy Grading Machinery," by Walter J. Brooking, Director of Tests and Research at R. G. LeTourneau, Inc., Peoria, Ill.

A great believer in the superiority of the arc-welding process for the fabrication of steel equipment over the older methods of fabrication, Mr. Brooking's talk pointed out the control of welding from the drafting room symbols, to setup positioners, control of fit-up and stepwise welding procedures to insure standardized operations and uniform products. His talk was accompanied by slides and a 16-mm. sound film.

Mr. Brooking is a graduate of the University of Chicago. He has been associated with R. G. LeTourneau, Inc., since 1935 where he has been in intimate contact with time study, welding engineering, testing and research.

An added attraction of this meeting was the showing of a sound film by the Office of War Information.

A coffee talk, "The Other Side of the Horizon," was given by Mr. James Callahan, who spent eight years in the U. S. Merchant Marine Service. Mr. Callahan outlined his views and experiences during visits to most of the Mediterranean countries.

Mr. Cyril Bath is scheduled for the November 10th meeting. His subject will be "Welded Brakes and Their Use in the Welding Shop."

The Cleveland Section now boasts a membership of 315, which is a 100% increase in less than ten years.

COLUMBUS

The October meeting held on October 8th in the Southern Hotel, was preceded by a dinner. The speaker was John R. Morrill, Assistant to the Vice-President, Lincoln Electric Co., Cleveland, O., who talked on "Welding World of Tomorrow."

The schedule of future meetings is as follows:

November 12, 1943—Dinner Meeting, Southern Hotel. "Eutectic Low-Temperature Welding and Brazing," by H. W. Foege, Mid-Western Sales Manager, Eutectic Welding Alloys Co.

December 10, 1943—Dinner Meeting, Southern Hotel. "Magnaflux and Zyglo Inspections," by R. N. Baughman, Manager, Cleveland Office, Magnaflux Corp.

January 14, 1944—Meeting, Battelle Memorial Institute. "Structural and Ship Welding," by LaMotte Grover, Structural Engineer, Air Reduction Sales Co.

February 11—Dinner Meeting, Southern Hotel. "The Metallurgy of the Weld and How Welding Affects the Parent Metal," by W. J. Conley, University of Rochester, Acting Chairman, Department of Engineering.

March 10—Dinner Meeting, Southern Hotel. "Welding with Aluminum Bronze," by Roy Norton, Ampco Metal, Inc.

April 14—Dinner Meeting, Southern Hotel. "Welding with Stainless Electrodes," by R. D. Thomas, Jr., Director of Research and Engineering, Arcos Corp.

May 12—Meeting, Battelle Memorial Institute. "Welded Steel Tubing," by H. S. Card, Formed Steel Tube Institute.

DETROIT

The Flint group and the Detroit Section, A.W.S., were privileged to have another outstanding pair of meetings last week. A Symposium on the Welding of Light Alloys was developed, with Mr. W. S. Loose of the Dow Chemical Co., Midland, Mich., presenting the subject of "Magnesium Welding," while Mr. Bill Cain, Assistant Welding Supervisor of the Ford Willow Run Bomber Plant, told the story of "Spot Welding of Aluminum."

The subject matter in both instances proved to be intensely interesting and the manner of its presentation left nothing to be desired. The discussions which followed proved the timeliness of the subject and the interest of our members.

The next regularly scheduled meetings are for November 4th and 5th in Flint and Detroit, respectively, at which times Mr. Spence of the Stoody Co. will cover the subject of "Hard Surfacing" and a discussion period on "Flame Hardening" is scheduled.

INDIANAPOLIS

The first meeting was held September 17th at Cifaldi's Villa Nova. The dinner, at which 64 were served, was very much enjoyed by everyone. After this there was an introduction of the new officers and a self-introduction of everyone present.

A talk explaining the work and the benefits of the SOCIETY was then given by the new chairman, Mr. J. R. Wirt. At this time he also presented the retiring chairman, Mr. E. F. Gilyeat, with a "Past-Chairman" pin.

Mr. Harold Russell of Sciaky Bros. Co., Chicago, Ill., the speaker of the evening, gave a very interesting lecture on "Practical Solution of Problems in Welding Aluminum." At the end of the lecture

the meeting was open for questions. Many were asked, and they were very readily and expertly answered by Mr. Russell.

KANSAS CITY

The first regular meeting of the Kansas City Section was held Tuesday evening, September 14th, at Fred Harvey's restaurant.

The new chairman, Mr. Edgar H. Finlay, called the meeting to order and presented Mr. Wm. S. Farr with a "Past-Chairman" lapel pin in recognition of his excellent work as chairman during the 1942–43 season.

After a heroic struggle by some of our eminent engineers to assemble the screen for the illustrated lecture, the guest speaker of the evening was presented. The speaker, Mr. Scott Baumer, steel mill specialist of the General Applied Engineering Department, Air Reduction Sales Co., New York City, presented to the 28 members present, a very interesting illustrated lecture on "Oxygen Lance and Flame Cutting Applications as Used in the Steel Mills," calling particular attention to the "speeding up" of various operations accomplished by the use of these relatively new tools. He also included slides and remarks concerning maintenance and salvage work accomplished by the use of thermit welds and hard facing welding for worn and broken equipment.

LEHIGH VALLEY

The Lehigh Valley Section inaugural meeting was held on October 4th at the Hotel Bethlehem, Bethlehem, Pa. About 150 members and guests were present with approximately 75 persons attending the dinner which preceded the meeting.

The following is the list of officers for the year 1943–44: *Chairman*, H. W. Lawson, Bethlehem Steel Co.; *Vice-Chairman*, J. W. Kenworthy, Mack Manufacturing Co.; *Secretary-Treasurer*, Julius Naab, Ingersoll-Rand Co.; *Past Jr. Chairman*, H. O. Hill (*ex officio*). *Directors:* G. E. Doan, C. W. Reid, F. R. Fairhurst, C. L. Kreidler, L. D. Draper, P. H. Barron.

Chairman Lawson presided at the meeting and the By-Laws were adopted as presented. H. O. Hill, a Director of the Society, sketched a brief history of the Society and explained the grades of membership and workings of the Society.

The speaker of the evening was C. H. Jennings who is in charge of Welding Research for the Westinghouse Electric and Manufacturing Co. Mr. Jennings spoke on "Distortion Problems in Welding" and considered the subject of distortion and residual stresses from the standpoint of magnitude, importance on the service life of a structure and methods of elimination such as peening, prestressing and strain annealing. Mr. Jennings presented his story in an understandable and non-technical way.

The speaker for the November 1st meeting was P. H. Merriman of the Glenn L. Martin Company. His subject was "Welding in Aircraft Production."

Other scheduled meetings are:

December 6, 1943—Hotel Bethlehem. "Fabrication of Ships and Buildings," by LaMotte Grover, Air Reduction Co.

February 7, 1944—Hotel Bethlehem. "Welding Electrodes," by Dr. J. W. Miller, Reid-Avery Co.

March 6—Hotel Bethlehem. "Structural Steel Fabrication by Resistance Welding," by R. T. Gillette, General Electric Co.

April 3—Hotel Bethlehem. Subject and speaker will be announced later.

May 1—Inspection trip to local plant if war conditions permit.

LOS ANGELES

The September meeting was held on the 16th at which time an address was given by Montgomery G. Cellers, Welding Superintendent of the Seattle-Tacoma Shipbuilding Corp. Mr. Cellers was well received by 265 members and guests. His lecture presented "Welding Sequence in Shipbuilding."

LOUISVILLE

The organization and dinner meeting was held on October 26, 1943, at the Brown Hotel Roof Garden, Louisville, Ky. K. L. Hansen, President of the A.W.S., gave a brief address on the activities of the Society.

The following officers have been nominated:

Chairman, Theodore H. Lewis, Jeffersonville Boat & Machine Co.; *Vice-Chairman*, E. H. Dilley, Tube Turns Incorporated; *Treasurer*, Fred Lythikainen, Blaw-Knox Co.; *Secretary*, William Dettmar, American Air Filter Co. Board of Directors: J. X. Merkt, Air Reduction Sales Co.; J. W. Rollie, Republic Welding Co.; J. M. Pool, Louisville Welding Works; J. C. Ray, Louisville Bridge Co.; G. W. Plinke, Henry Vogt Machine Co.; E. F. Schulz, Louisville & Nashville Railroad Co.

MILWAUKEE

The Milwaukee Section held a meeting on October 1st, at the Cudworth Post—American Legion, 1756 North Prospect Ave. The meeting was preceded by a dinner. A paper on "Magnaflux and Zyglo Inspection of Welds" was presented by W. E. Thomas, Manager of Field Engineering, Magnaflux Corp.

NEW JERSEY

The September meeting was held at the Essex House, Newark, N. J., on September 21st. Mr. Wayne E. Wilson, of the General Electric Co., presented an address on "Atomic-Hydrogen Arc Welding" and a motion picture on "The Inside of Atomic-Hydrogen Arc Welding." Atomic-hydrogen arc welding is playing an ever increasing role in war production. Equipment for both manual and automatic welding is available.

Other meetings of the Section are:

October 26—Film, "To Each Other," courtesy of U. S. Steel Corp. Paper, "Procedure Control and Design for Large Welded Structures," by LaMotte Grover, Air Reduction Sales Co.

November 16—Illustrated lecture, "Changeover from Riveted to Welded Construction of Combat Tanks," by J. W. Sheffer, American Car and Foundry.

December 20—Film, "Fabrication of Stern Frames for Victory and Liberty Ships by Thermit Welding," courtesy of Metal & Thermit Corp. Paper, "Arc Welding Mild Steel Electrode Coating Constituents—Their Effect on Position, Quality and Speed of Welding. Health Hazards. Proper Methods of Storage and Handling," by O. T. Barnett, Metal & Thermit Corp.

January 18, 1944—Demonstrated lecture, "Temperature Indicators," by R. J. Pass, Tempil Corp. Paper, "Metal Spraying," by W. C. Reid, Metallizing Engineering Co. of America.

February 15—Film, "Testing by Magnaflux," courtesy of Magnaflux Corp. Paper, "Non-destructive Testing Methods," by R. J. Allen and R. T. Purcell, Worthington Pump and Machinery Corp.

March 21—Film, to be announced, courtesy of U. S. Bureau of Mines. Paper, "Welding of Non-ferrous Copper Base Alloys," by J. J. Vreeland," Chase Brass Co., and K. L. Walker, Foster Wheeler Corp.

April 18—Film, "Manufacture of Electric Resistance Welded Boiler Tubes," courtesy of Republic Steel Corporation. Paper, "Resistance Welding," Federal Machine & Welder Company.

May 18—Annual meeting.

NORTHWEST

The October meeting of the Northwest Section was held on the 13th in Coffmann Memorial Union, University of Minnesota. James F. Lincoln, President, Lincoln Electric Co., Cleveland, Ohio, spoke on "The Effect Welding Has on Reducing the Cost of Manufacture."

OKLAHOMA CITY

The Oklahoma City Section opened its 1943–44 season with a meeting at 8:00 P.M., on September 9th, at the Biltmore Hotel. An excellent paper, augmented by slides, was presented by Mr. Arthur J. Williamson, Chief Metallurgist, Summerill Tubing Company, Bridgeport, Pa. His topic, "Welding of Aircraft Tubing," was well received and drew a good discussion. He conveyed much valuable and interesting information concerning both the welding and manufacture of seamless steel tubes.

At this meeting, amendments to the Section By-Laws proposed by the Executive Committee were accepted by vote. The Educational Chairman, C. C. Willis, outlined some of that committee's plans for the near future. Among the non-members present were a representative group from the Douglas Aircraft Company's Oklahoma City plant, and the Air Service Command's Oklahoma City Air Depot.

PHILADELPHIA

The schedule of regular meetings of the Philadelphia Section for 1943–44 are as follows:

October 18—Subject, "Training, Inspection and Qualification of Welding Operators." Panel discussion, directed by

Mr. John D. Bert, Welding Engineer of the Philadelphia Navy Yard.

November 15—Subject, "Combat Repairs." The problems of field repair and maintenace, as presented by men who have "been there," will provide an exciting evening.

December 20—Subject, "Welding in Ship Construction." J. Lyell Wilson, Assistant Chief Surveyor of the American Bureau of Shipping and an active member in both the A.W.S. and the Society of Naval Architects, will discuss some of the difficulties and problems of welded ships. Mr. Wilson is in a position to known exactly what has occurred and his analysis will be well worth hearing. This will be a joint meeting with the Philadelphia Section of the Society of Naval Architects.

PITTSBURGH

The October meeting was held on October 13, in the Auditorium, Mellon Institute of Industrial Research. "Inspection of Welded Structures" was presented by R. B. Lincoln, Director, National Weld Testing Bureau (Division of Pittsburgh Testing Laboratory), Pittsburgh, Pa. His discussion covered a wide field, with special emphasis on welding of pipe, structural steel, ships, dry-docks, machinery-parts and castings, dealing briefly with the inspection of fit-up before welding, observation of welding through welder's glass, inspection of individual layers, final inspection, trepanning, X-ray and Gamma-ray examination, etc. He also covered briefly the Qualification of the Welding Process and the Qualification of Welders.

PUGET SOUND

The first fall meeting was held on September 30th, in the Hotel Gowman, Second Ave. and Stewart St. Mr. P. F. Spaulding, General Superintendent of Steel Construction, Seattle-Tacoma Shipbuilding Corp., Tacoma, was the speaker at this meeting. His subject was the sequence of welding in construction of escort carriers.

Also, a film depicting the construction of escort carriers was shown during the meeting.

ROCHESTER

The October meeting of the Rochester Section was held on the 7th in Lower Strong Auditorium, University of Rochester, River Campus, preceded by a dinner at the Rush Rhees Library Cafeteria. The speaker was E. J. Vom Steeg, Jr., General Electric Welding Specialist, whose subject was "The Inside of Atomic-Hydrogen Arc Welding." A two-part film on this subject was shown.

TOLEDO

The regular membership meeting of the Toledo Section was held on September 21st at the Commodore Perry Hotel. Mr. E. A. Mallett, Application Engineer of the Taylor-Winfield Corp., gave an interesting talk on "Resistance Welding." He discussed the various problems concerning designing and its mechanical and electrical principles. An illustrative movie was shown.

Mr. Dean, chairman of the program committee, announced that the next meeting would have as its main subject, "Inspection of Welding." He said that he expected to invite leading representatives of the U. S. Navy and U. S. Army to discuss this subject.

On October 5th, Mr. Walter R. MacCornack, Chairman of the Committee on Post-War Reconstruction and Vice-President of the American Institute of Architects, and Dean of the College of Architecture, M. I. T., gave an address on "We Will Build Again." This lecture was given under the auspices of the Toledo Technical Council and was held at the Doermann Theatre, University of Toledo.

WESTERN MASSACHUSETTS

The 1943–44 season opened with a September meeting.

The following officers were elected:

Chairman, W. A. Emery, Superintendent of Welding, Worthington Pump & Mach. Corp.; *Vice-Chairman*, H. S. Hill, Works Manager, Cheney Bigelow Wire Works; *Treasurer*, H. W. Walsh, Methods Engineer, Worthington Pump & Mach. Corp.; *Secretary*, J. J. Kapinos, Chief Inspector of Welding, Worthington Pump & Mach. Corp. *Directors at Large:* (two years) F. H. Jones, Welding Supervisor, Worthington Pump & Mach. Corp., M. I. Stray, Industrial Sales Manager, J. Russell & Co., Inc., C. R. Black, Sales Engineer, Smith Welding Equipment Co.; (one year), R. T. Perrine, Welding Supervisor, Cheney Bigelow Wire works, Miss Beatrice Bentley, Welding Inspector, Worthington Pump & Mach. Corp., E. Stolte, Manufacturing Engineer, Westinghouse Elect. & Mfg. Co.

Mr. George L. C. Dehn, of the Magnaflux Corp., gave a talk on "Welding Inspection with Magnaflux." Subjects covered were: magnaflux principles, machines, indications of defects, sensitivity of the method, and several practical applications. An extended question period brought forth many interesting questions.

WICHITA

The September meeting was held on the 8th and was preceded by a dinner. The technical meeting, attended by 172 members and guests, began promptly at 8 P.M. This was the largest turnout in the history of the Wichita Section.

Mr. A. J. Williamson, Chief Metallurgist, Summerville Tubing Co., Bridgeport, Pa., delivered an instructive and entertaining lecture on manufacture, welding, heat treating and stress relieving of tubular structures. The reaction of the audience was excellent and many requests for additional information were made during the open forum period directly after Mr. Williamson completed his talk.

Management and engineering personnel of leading local plants made up almost the entire audience. Publicity in local newspapers, a mailing list of 500 and personal efforts of present members all contributed to the excellent turnout.

List of New Members

September 1 to September 30, 1943

ATLANTA

Martin, Bunn H. (C), Georgian Terrace, Atlanta, Ga.
Rozema, Nicklaas (C), East Point, Ga.

BOSTON

Dorwin, Theodore (D), 26 Lyford St., Dorchester, Mass.
McGraw, Ed. H. (B), 24 Concord Ave., Cambridge, Mass.
Moretti, Frank (B), 535 Niantic Ave., Cranston, R. I.
Pousland, Mrs. Esther (D), 654 Mass Ave., Boston, Mass.

CANADA

Caron, Alphonse (B), 62 Boulevard Langelier, Quebec City, Canada.

CANTON

Peterson, Frank (B), Republic Steel Corp., Berger Div., 1038 Belden Ave., N. E., Canton, Ohio.

CHICAGO

Craven, Frederic H. (C), Bendix Aviation Corp., 401 Bendix Dr., So. Bend, Ind.

...then perhaps he said to himself

A TEN-MONTH DELIVERY

MR. ROOSEVELT'S LETTER
President Roosevelt's letter to Mr. Churchill read as follows:
Dear Mr. Prime Minister:
When you were with us during the latter part of December, 1941, and the first few days of 1942, after we had become active participants in the war, plans for a division of responsibility between your country and mine became
Here there had been developed a welding technique which enables us to construct standard merchant ships with a speed unequaled in the history of merchant shipping.

BIG PIECE OF NEWS the Prime Minister read to the House of Commons—the 10-months' delivery of a couple hundred ships.

Again the old formula: BIG name in the NEWS . . . made big by Big Production . . production made big by RECOURSE TO ARC WELDING (remembering Webster's short definition of RECOURSE as "a going to for aid or protection").

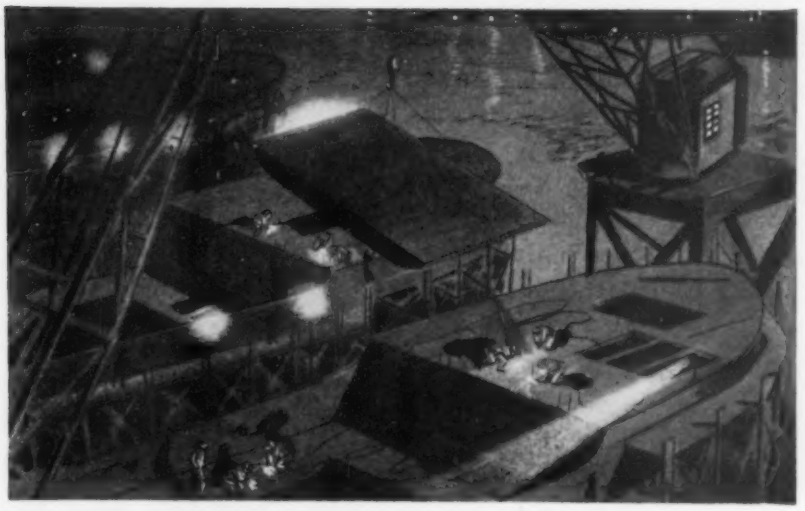
So the President has written the formula into the history of the world: "Here there had been developed a welding technique . . . with speed unequaled."

THE LINCOLN ELECTRIC COMPANY • *CLEVELAND 1, OHIO*

"A Welding Technique" *he said*

★ ★ ★ ★ *"with speed unequalled in the history of merchant shipping"*

...and this, Mr. Prime Minister, is what he meant:



SHOP FABRICATION. Ships welded on a production line by assembly line methods—faster welding by positioning the welding—pre-fabrication of large sections—upside-down assembly—dozens of short-cuts make up this technique, recourse to which has revolutionized shipbuilding.

MASS PRODUCTION. If ships can be put on a mass production basis, think of the speed and economy in producing products less bulky. If speed alone were the only benefit of welding, *recourse* to it might be debatable. But consider these additional benefits:

LESS STEEL
On these 200 ships, *recourse* to arc welding saves 375,600 tons. Steel is critical. Steel costs money.

LESS HULL FRICTION
A welded Liberty ship leaving New York would reach Sicily 40 hours quicker than its rough-skinned sister of equal horsepower.

INCREASED CARGO
18% more cargo carrying capacity is provided by weight-cutting through *recourse* to arc welding.

America's greatest natural **recourse**

ARC WELDING

to 20 Ships a Month

der that the general un-
nding we reached, during
rly days of our engagement
her in this war, may be
perfectly carried out, and
der as a practical matter to
d the prodigal use of man-
er and shipping that would
lt from pursuing any other
rse, I am directing the War
ipping Administration, under
propriate bareboat arrange-
ents, to number to your flag
r temporary wartime duty dur-
ng each of the suggested next
ven months a minimum of fifteen
ships.

I have furthermore suggested to them that this be increased to twenty.

We have been allocating to British services on a voyage-to-voyage basis large numbers of American-controlled ships. What I am now suggesting to you, and what I am directing the War Shipping Administration to carry out, will be in the nature of a substitution to the extent of tonnage transferred for the American tonnage that has usually been employed in your war program.

Details of the arrangements we can properly leave to national shipping authorities for settlement through the Combined Shipping Adjustment Board, whose function it is to concert employment of all merchant vessels, and will in accordance with its usual practice do so in connection with these particular ships.

Always sincerely,

FRANKLIN D. ROOSEVELT.

Dunn, U. S. (B), 179 W. Washington St., Chicago, Ill.
Grimm, Carl W. (A), Henry Pratt Co., 2222 South Halsted St., Chicago, Ill.

CINCINNATI

Quinn, John W. (C), 319 Fernwood, Dayton 5, Ohio.

CLEVELAND

Connell, Edward P. (B), The Harris Calorific Co., 5501 Cass Ave., N. W., Cleveland, Ohio.
Pfeil, C. Wm. (C), 1475 Marlowe Ave., Lakewood, Ohio.

COLUMBUS

Bennett, Robert W. (C), Battelle Memorial Institute, 505 King Ave., Columbus, Ohio.
Disbennett, C. B. (C), 1115½ Dennison Ave., Columbus, Ohio.
Longfellow, Floyd A. (B), 101 S. Broadway, Greenville, Ohio.
Pittman, Geo. F. (B), 53 Clover St., Fairfield, Ohio.

CONNECTICUT

Lautier, Roger A. (C), Bantam, Conn.

DETROIT

Adams, P. E. (C), Canadian Bridge Co., Box 157, Walkerville, Ont., Canada.
Ault, J. W. (C), 9947 Memorial Ave., Detroit, Mich.
Breil, J. W. (C), 8416 Whittaker, Detroit, Mich.
Brent, C. W. (B), Weldit Acetylene Co., 638 Bagley Ave., Detroit 26, Mich.
Busch, A. E. (C), Canadian Bridge Co., Box 157, Walkerville, Ont., Canada.
Chase, J. (C), Canadian Bridge Co., Box 157, Walkerville, Ont., Canada.
Colvin, Harold (C), Weldit Acetylene Co., 638 Bagley Ave., Detroit 26, Mich.
Craig, Leslie M. (B), Steel Plate & Shape Corp., 15050 Woodward Ave., Detroit, Mich.
Davies, G. V. (C), Canadian Bridge Co., Box 157, Walkerville, Ont., Canada.
Doerfler, P. F. (C), Canadian Bridge Co., Box 157, Walkerville, Ont., Canada.
Dugan, D. J. (C), 14731 Winthrop Ave., Detroit, Mich.
Hegge, Robt. H. (C), 13023 Evanston Ave., Detroit, Mich.
Kennedy, J. J. (C), 3334—20th St., Wyandotte, Mich.
Kirkwood, J. G. (C), Canadian Bridge Co., Box 157, Walkerville, Ont., Canada.
Jenkins, Kenneth W. (C), 7017 N. Telegraph Rd., Dearborn, Mich.
Nickel, Horace (C), 19301 St. Mary's Ave., Detroit, Mich.
Parr, F. W. (C), Canadian Bridge Co., Box 157, Walkerville, Ont., Canada.
Ryley, A. St. C. (B), Canadian Bridge Co., Box 157, Walkerville, Ont., Canada.
Tack, John (C), 16803 Fenmore Ave., Detroit, Mich.

KANSAS CITY

Hockett, Bruce E. (B), Standard Steel Wks., 16th & Howell, No. Kansas City, Mo.

LEHIGH VALLEY

Balmat, Robert E. (C), 430 Main St., Bethlehem, Pa.
Beckett, Joe D. (C), 349 Union St., Allentown, Pa.
Benyi, Edward (C), Bethlehem Steel Co., Service Div., Bethlehem, Pa.
Bortz, Francis V. (B), 2335 Park Ave., Easton, Pa.
Decker, Walter A. (C), Lehigh Valley R.R., 425 Brighton St., Bethlehem, Pa.
Edelman, Paul S. (C), 818 Fifth St., Fullerton, Pa.
Elly, Leonard P. (C), 75 E. Broad St., Bethlehem, Pa.
Farenwald, John (C), 2104 Sycamore St., Bethlehem, Pa.
Fluck, Roger I. (C), 516 Center St., Bethlehem, Pa.
Gray, George L. (C), R. D. 2, Bethlehem, Pa.
Hanto, H. H. (C), 251 Tenth Ave., Bethlehem, Pa.
Hersh, George W., Jr. (B), Lehigh Engineering Co., 1150 Mauch Chunk Rd., Bethlehem, Pa.
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McDermott, Thos. J. (C), 517 No. St. George St., Allentown, Pa.
Nagy, Gager (C), Pohatcong St., Alpha, N. J.
Newman, Clarence S. (C), R. D. 2, Easton, Pa.
Patten, Charles H. (C), 135 S. West St., Allentown, Pa.
Peters, Clarence S. (B), 1055 N. 22nd St., Allentown, Pa.
Slegel, Russell S. (C), 2626 Stephen St., Easton, Pa.
Smith, Ira C. (C), 1066—7th St., Catasaqua, Pa.
Stout, Robert D. (C), Dept. of Metallurgy, Lehigh University, Bethlehem, Pa.
Taylor, John, Jr. (B), 616 N. 22nd St., Allentown, Pa.
Walck, John A. (C), West 4th St., East Stroudsburg, Pa.
Zahm, Wm. W. (C), 1624 Cloverleaf St., Bethlehem, Pa.

LOS ANGELES

Gabel, Louis E. (C), 519 Avenue B, Redondo Beach, Calif.
Gardner, G. W. (D), P. O. Box 413, Wilmington, Calif.
Haugh, Carlton B. (C), 1007 Santa Fe, Los Angeles, Calif.
Marvin, Everett H. (C), 1309 E. 63rd St., N. Long Beach, Calif.
Nelles, Maurice (C), 3713 Laurel Canyon, North Hollywood, Calif.
O'Neill, Donald Raymond (C), 2721 E. 218 Pl., Long Beach, Calif.
Probert, Margaret (C), 1120 Marion Dr., Glendale, Calif.
Thompson, Hal (C), 1915 Cedar Lodge Terrace, Los Angeles 26, Calif.
White, James E. (C), 1366 Ronan Ave., Wilmington, Calif.
Williams, W. A. (C), 3070 Chestnut Ave., Long Beach, Calif.

LOUISVILLE

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Luckert, Milton C. (C), Koppers Co., B. H. Div., 200 Scott St., Baltimore 27, Md.

MILWAUKEE

Cramer, Robert, Jr. (B), Nordberg Mfg. Co., Milwaukee, Wis.
Engleman, Oscar P. (B), 3009 No. 59th St., Milwaukee, Wis.
Erickson, Helmar E. (B), 3134 So. Lenox Ave., Milwaukee, Wis.
Field, George A. (C), 21 N. Pearl St., Janesville, Wis.
Graske, Joseph G. (B), 615 E. Russell Ave., Milwaukee, Wis.
Werner, Ewald (B), 3795 So. Kuinickinnic Ave., Milwaukee, Wis.

MOBILE

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Bague, John H. (C), Turner Supply Co., Mobile, Ala.
Guthrie, Raymond B. (C), Turner Supply Co., Mobile, Ala.
Tonsmeire, Henry B. (B), Turner Supply Co., Mobile, Ala.

NEW JERSEY

Anderson, R. H. (B), The Singer Mfg. Co., Elizabethport F, N. J.
Dolan, W. (B), Foster Wheeler Corp., Carteret Wks., Carteret, N. J.
Evans, H. (B), Foster Wheeler Corp., Carteret Wks., Carteret, N. J.
Matis, J. (B), Foster Wheeler Corp., Carteret Wks., Carteret, N. J.
Peinhardt, Hilmar O. (B), 124 Paine Ave., Irvington, N. J.
Robertson, G. (B), Foster Wheeler Corp., Carteret Wks., Carteret, N. J.

NEW YORK

Bergin, Harrison D. (C), 42-17—204th St., Bayside, N. Y.
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Domer, Loy G. (B), Combustion Engrg. Co., 200 Madison Ave., New York 16, N. Y.
Ford, Bernard (B), Tech. Aircraft Specialties, Inc., 295 Jericho Turnpike, Floral Park, N. Y.
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Gilles, Hans (B), 102 Jerome St., Brooklyn, N. Y.
Gonta, Stephen (D), 284 St. Ann's Ave., Bronx, N. Y.
Graffagnino, Steven (C), 348 So. 15th St., Lindenhurst, N. Y.
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Moon, John A. (C), 14 E. 47th St., New York 17, N. Y.
Orsher, A. N. (B), Toughard Metals Sales Corp., 420 Lexington Ave., New York, N. Y.
Robinson, Harold (C), 10 Montague Terrace, Brooklyn, N. Y.
Sherman, Herbert (C), The Greene Wolf Co., Inc., 243-40th St., Brooklyn 32, N. Y.
Wadeleigh, Clifford H. (C), 172 Lincoln St., Jersey City, N. J.

NORTHWEST

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Fitzgerald, J. Glenn (C), 762 Sherburne Ave., St. Paul, Minn.

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Staggs, Lydle (C), 2905 Dorman Ave., Minneapolis, Minn.
Whitlock, G. Harry (B), 209 Junius E., Fergus Falls, Minn.

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Secretan, A. M. (C), R. R. 2, Peoria 5, Ill.

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Loewenstein, Fritz (C), 212 Delaware St., New Castle, Del.
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Stein, Joseph F. (C), Ridge Rd., East Anbridge, Pa.

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Foster, Jim H. (B), Dash Point, Wash.
Moe, Edwin E. (B), 4119 No. 15th St., Tacoma, Wash.
Paul, Walter J. (B), 4058 S. 36th, Tacoma 5, Wash.
Sinner, Ruben P. (B), T. F. D. 2, Box 2, Tacoma, Wash.
Tapley, I. C. (D), 2906 Hemlock Dr., Sheridan Pk., Add., Bremerton, Wash.

ROCHESTER

Casey, Donald(C), 16 George St., Fairport, N. Y.

ST. LOUIS

Dalton, John H. (C), East Alton Mfg. Co., E. Alton, Ill.

SAN FRANCISCO

Austin, J. R. (B), 35 E. Mariposa, Stockton, Calif.
Boone, Arthur W. (B), 1153 So. 29th St., Harbor Gate, Richmond, Calif.
Bryan, Ray (C), 3643 16th St., San Francisco, Calif.
Edwards, S. H. (B), S. H. Edwards Engrg. & Mfg., 1527 Barrett Ave., Richmond, Calif.
Loube, Irving (B), Moore Dry Dock Co., Foot Adeline St., Oakland, Calif.
Mumford, Kenneth L., S.F. 1/C (D), Co. D 15th Naval Constr. Bn., % Fleet P. O., San Francisco, Calif.
Robinson, Arthur R. (B), 3868 Greenwood Ave., Oakland, Calif.
Robinson, Charles B. (C), 722 Arkansas St., Vallejo, Calif.
Snorton, John B. (C), 213—5th St., Apt. 185, Vallejo, Calif.
Van Buening, Louis E. (B), 1235 33rd Ave., Oakland, Calif.

TOLEDO

Hill, William T. (B), 1620 Woodland Ave., Toledo 7, Ohio.
Myers, Richard W. (C), 1841 Balkan Pl., Toledo 12, Ohio.
Shultz, O. C. (A), National Supply Co., 3320 Bishop St., Toledo, Ohio.

TULSA

Speegle, A. G. (B), Vulcan Steel Tank Corp., P. O. Box 1844, Tulsa 1, Okla.

WASHINGTON, D. C.

Davis, S. Mathwin (C), British Admiralty Delegation, Box 165, Benjamin Franklin Sta., Washington, D. C.
Gilson, T. J. (D), 706 Avon Pl., Alexandria, Va.
Guerreire, Renato I., Major (C), 2134 Leroy Pl., N. W., Washington, D. C.
Khimoushin, Feodor F. (B), 3355 16th St., N. W., Washington, D. C.
Nelson, Edward C. (C), Metallurgy Div., Naval Research Lab., Anacostia Sta., Washington, D. C.

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Koopman, Kenneth H. (B), Union Carbide & Carbon Res. Lab., P. O. Box 580, Niagara Falls, N. Y.
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McNaught, John C. (C), Electro Metallurgical Co., 47th St., Niagara Falls, N. Y.
Rooney, Albert (C), 64 Forest Ave., Buffalo, N. Y.

YORK-CENTRAL PENNSYLVANIA

Bradburn, Charles A. (C), 1947 Chestnut St., Harrisburg, Pa.
Brown, Lester E. (D), East Berlin, Pa.
Congemi, Thomas N. (C), 40 Wood St., S. Coatesville, Pa.
Douglass, Earl E. (D), 357 E. Philadelphia St., York, Pa.
Duncan, Charles (D), 1582 West King St., York, Pa.
Dupler, Paul (D), 18 Eichelberger St., Hanover, Pa.
Eichelberger, Robert F. (D), 543 East Walnut St., Hanover, Pa.
Etters, Lloyd E. (D), 332 Atlantic Ave., York, Pa.
Filmore, Ray I. (D), York Safe & Lock Co., York, Pa.
Fogle, Earl (D), 223 Park Pl., York, Pa.
Gladfelter, John N. (D), R. D. 1, Mt. Wolf, Pa.
Gohn, Wilton L. (D), Craley, Pa.
Graham, Kenneth G. (D), Craley, Pa.
Graham, Lester (D), R. 1, Wrightsville, Pa.
Haverstick, Harvey (D), Rohrerstown, Pa.
Hoover, Paul (D), R. D. 1, East Berlin, Pa.
King, Loyd M. (D), 115 S. Duke St., 3rd Floor, York, Pa.
Miller, Chester (D), 725 Weaver Ave., York, Pa.
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Olewiller, G. William (D), Craley, Pa.
Powell, George Leroy (D), 606 Bergman St., York, Pa.
Ramsay, William H. (D), 818 E. Philadelphia St., York, Pa.
Rohrer, Paul V. (D), 641 W. Locust St., York, Pa.
Schellenberg, Frank S. (C), 108 Highland Ave., Lewistown, Pa.
Schmid, William (D), 8 Latimer St., N., York, Pa.
Schnell, Wilmer R. (D), Glen Ave., Glen Rock, Pa.
Seitz, Isodor (D), R. D. 1, York, Pa.
Seitz, Leo B. (C), 301 Garden Lane, Hillcroft, York, Pa.
Shewell, Clarence E. (D), 319 E. Locust St., York, Pa.
Sitler, Gordon (D), Craley, Pa.
Snyder, Harold L. (C), Honey Brook, Pa.
Spiese, Richard L. (D), 727 So. Beaver St., York, Pa.
Stahl, Edwin (D), 809 E. Philadelphia St., York, Pa.
Sterner, Loyd (D), 361 E. Philadelphia St., York, Pa.
Thomas, Kenneth D. (D), Craley, Pa.
Trout, Harry E. (D), R. D. 1, York, Pa.
Tudas, William (D), 744 East King St., York, Pa.
Velardi, Fred C. (D), 521 Madison Ave., York, Pa.
Wagner, Cleon E. (D), 51 S. Sixth St., Columbia, Pa.
Wert, Wallace H. (D), York Safe & Lock Co., York, Pa.
Wire, Luther A. (D), 213 Irving Rd., York, Pa.
Zeigler, Charles H. (D), R. D. 1, East Berlin, Pa.
Zirkle, Earl W. (D), R. F. D. 3, Dover, Pa.

NOT IN SECTIONS

Adam, John L. (B), 14 Blythswood Sq., Glasgow, Scotland.
Bernstein, Paul L. (C), Welding Supply Co., 113 Larned St., Syracuse, N. Y.
Bogen, Samuel (B), Stowe Elec. Pty. Ltd., 2-6 Druitt Pl., Sydney, N. S. W., Australia.
Brannis, John W. (B), 763 E. Vine St., Kalamazoo, Mich.
Dixon, Robert L. (D), 2655 Cherry St., Erie, Pa.
Germond, Stanley E. (B), 58 Utica St., Clinton, N. Y.
Haddon, William T. (B), 183 Bwlch Rd., Fairwater Cardiff, South Wales, G. B.
Hamilton, Hermes H. (B), Clinton Farm Supply, Clinton, N. Y.
Hanna, Emil E. (C), 1617 River Rd., South Jacksonville, Fla.
Horton, Fred (B), San-Equip., Inc., E. Brighton & Glen Aves., Syracuse 5, N Y.
Hotchkiss, Jack T. (C), 1590 Westmoreland Ave., Syracuse, N. Y.
Hull, Carlos L. (C), 3131 S. W., 13th St., Des Moines, Iowa.
Johnson, Calvin W. (C), 418 So. Crouse Ave., Syracuse, N. Y.
Johnson, Lois W. (C), 418 So. Crouse Ave., Syracuse, N. Y.
Kent, Eugene (B), 405 Washington St., Utica, N. Y.
Knowlton, Ernest (C), K & K Welding Wks., 104 First St., Syracuse, N. Y.
Kruger, W. A. (C), 2702 W. Genesee St., Syracuse, N. Y.

Electric Arc STUD

★

Automatic Stud Welder in operation. Studs furnished from 1/8" to 7/16" in diameter and from 1" to 8" in length.

★

End-welded stud and plate cut in half, showing complete fusion of plate and stud. (Welded area etched and polished to show dense structure of the weld.)

NELSON SPECIALTY WELDING EQUIPMENT

The Nelson WELDER

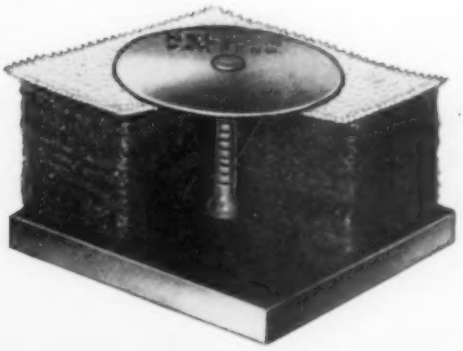
Save 75% of your time and material cost. Studs automatically end-welded in one-quarter of one second.

STUD USES

1. Securing wood decking.
2. Securing hangers for wireways; single, double, and multiple runs.
3. Securing hangers for pipe.
4. Securing plastic armor.
5. Securing plastic decking.
6. Securing all types of insulation material.
7. Securing wood furring strips.
8. Securing electric light fixtures and switch boxes.
9. Securing gun mounts.
10. Securing man hole covers.
11. Securing furniture.
12. Securing cargo battens.
13. Securing degaussing trough covers.
14. Drawing outer hull to template form.
15. Drawing steel plate to conform to shape.
16. Securing doubler plates.
17. Securing treadplates.
18. Spacing outer shell on uptakes.
19. Reinforcing concrete.
20. Securing chain to buoys.
21. Securing canvas weather stripping.

Now used in 120 major shipyards in the United States and Canada.

Wire for samples, catalog, price list, etc.



head pointed Nelson insulation pin, end-welded through insulation
erial, with cut-out section to show method.

NT CORP. DEPT. S SAN LEANDRO, CALIFORNIA

Kuc, Frank (B), San-Equip, Inc., E. Brighton & Glen Aves., Syracuse 5, N. Y.
Larsen, Bernard O. (C), Apprentice Training School, Syracuse, N. Y.
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Mitchell, Charles H. (C), 436 Buckingham Ave., Syracuse, N. Y.
Mobley, Nelson E. (D), 248 E. 26th St., Erie, Pa.
Needham, Egbert Stephen (B), 24 Cecil Rd., Enfield, Middx., England.
Piazza, John J. (C), 414 Fabius St., Syracuse, N. Y.
White, Roy A. (B), Grand Rapids Junior College, 133 Barclay Ave., N. E., Grand Rapids 3, Mich.
Whitelaw, Andrew (C), Y. M. C. A., Syracuse, N. Y.

Members Reclassified

During Month of September

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Highwood, William (from D to C), 2334 Kemper Lane, Cincinnati, Ohio.
Pahner, Wm. F. (from C to B), R. R. 1, Box 45A, Sharonville, Ohio.

CLEVELAND

Graham, John (from C to B), American Steel & Wire Co., Rockefeller Bldg., Cleveland, Ohio.

DETROIT

Eckermann, Leo A. (from C to B), Steel Plate & Shape Corp., 15050 Woodward Ave., Detroit, Mich.
Ferris, Russell (from C to B), 1055 E. Bristol Rd., Flint, Mich.
Gilbert, Yowland (from F to C), 504 Thomson St., Flint 3, Mich.
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